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APPENDIX H

SAMPLING AND ANALYSIS PLAN

APPENDIX H.1
FIELD SAMPLING AND ANALYSIS PLAN

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H.1.1.0 INTRODUCTION

The purpose of this Field Sampling and Analysis Plan (FSAP) is to outline the protocols to be implemented during the Remedial Investigation/Feasibility Study to be conducted at the Four County Landfill Site in Fulton County, Indiana (Site). This FSAP together with the Quality Assurance Project Plan (QAPP) provided in Section H.2.0 of this Appendix are intended to serve as the Sampling and Analysis Plan (SAP) for the RI/FS at the Site.

The FSAP presents general field protocols, sampling protocols, analytical protocols, project organization, objectives and specific quality assurance/quality control (QA/QC) activities associated with the RI/FS. The SAP provides a reference for personnel responsible for implementing and oversight of field activities during the performance of the RI/FS.

H.1.2.0 PROJECT DESCRIPTION

The Four County Landfill Site is located approximately one mile south of the Town of Delong in Fulton County, Indiana. History and background of the Site is presented in Sections 2.0 through 5.0 of this RI/FS Work Plan.

H.1.2.1 PROJECT OBJECTIVES

The overall objective of the RI/FS is to gather sufficient information to complete an evaluation of the nature and extent of contamination at this Site for purposes of assessing risk and ultimately selecting the most suitable Site remedy.

H.1.2.2 SCOPE OF WORK

The scope of work for field activities which will be performed during the RI are summarized below:

- i) each of the existing Site monitoring wells and piezometers will be inspected;
- ii) twenty existing monitoring wells and piezometers will be properly abandoned;
- iii) groundwater samples will be collected from 71 existing monitoring wells and piezometers during the first investigative phase;
- iv) sediment and surface water samples will be collected from 20 locations located both on- and off-Site;
- v) hydraulic head data will be collected from the 71 monitoring wells and piezometers sampled during the RI;

- vi) response tests will be performed at eight monitoring wells screened in the B and C stratigraphic units; and
- vii) conduct additional characterization tasks, as required, after evaluation of the data compiled during the first phase.

All groundwater, surface water and sediment samples will be analyzed for contaminants which are likely to be present on the basis of historical data and information available for the Site. These compounds include the target compound list (TCL) volatile organic compounds (VOCs), TCL-semi-volatile organic compounds (SVOCs), target analyte list (TAL) metals and TAL cyanide. In addition to the above, groundwater samples will be analyzed for landfill indicator parameters such as hydrogen ion activity (pH), sulfate, chloride, nitrate, ammonia, total dissolved solid (TDS) total suspended solids (TDS) total suspended solids (TSS) and alkalinity. Sediment and surface water samples will also be analyzed for TCL pesticides and polychlorinated biphenyls (PCBs). Sediment samples will also be analyzed for total organic carbon (TOC).

H.1.2.3 RATIONALE

The rationale for each of the field tasks to be performed during the RI are presented in Section 7.0 of this work plan. In general, sampling and analytical protocols have been selected to identify likely contaminants of concern on the basis of available historical information and data generated for the Site. Sampling locations have been selected to provide wide areal coverage over the landfilled property and the various stratigraphic units present beneath the Site (in the case of groundwater) and locations where contaminants may be present as a result of runoff and sediment deposition (surface water and sediments).

H.1.3.0 GENERAL PROTOCOLS

H.1.3.1 EQUIPMENT CLEANING

H.1.3.1.1 Drilling Equipment

Upon mobilization of the drill rig to the Site, and prior to commencing drilling, the rig and all associated equipment will be thoroughly steam cleaned to remove oil, grease, mud and other foreign matter. Before initiating drilling at each subsequent well abandonment location, the drill rods, cutting bits, samplers, hand auger, drill steel and associated equipment will be cleaned to prevent cross-contamination from the previous drilling. Cleaning will be accomplished by flushing and wiping the components to remove all visible sediments followed by:

- i) steam clean or high pressure wash with tap water and Alconox™ detergent using a brush if necessary to remove particulate matter and surface films; and
- ii) a thorough rinse with tap water.

H.1.3.1.2 Sampling Equipment

All sampling equipment will be decontaminated prior to field use and after each sample is collected to prevent cross-contamination between samples. Duplicate samples shall be collected concurrently with original samples; therefore, sampling equipment will not be decontaminated before collection of the duplicate. Decontamination of equipment will be performed as follows:

- i) clean water and Alconox™ detergent wash using a brush, if necessary, to remove all visible foreign matter;
- ii) rinse thoroughly with potable water;

- iii) rinse with isopropyl alcohol;
- iv) rinse thoroughly with deionized or distilled water;
- v) allow the equipment to air dry on a clean plastic sheet as long as possible; and
- vi) wrap in aluminum foil until ready to use.

Following final rinse, openings will be visually inspected to verify they are free of soil particulates and other solid material which may contribute to possible sample cross-contamination.

The Grundfos MP-1 or similar submersible pump and hose will be decontaminated between sampling locations using the following protocol:

- i) The submersible pump and attached hose will be submerged in a suitably sized container which contains an Alconox and water solution.
- ii) The outer casing of the submersible pump and the outer portion of the PVC hose will be cleaned using a brush to remove sediment or particulate matter. Upon completion of this procedure, the submersible pump will be started and detergent solution will be allowed to run through the pump and hose for a period of at least three minutes.
- iii) The submersible pump and attached hose will then be placed in a suitably-sized container of potable water and turned on. Potable water will then be allowed to run through the pump and hose to flush out the detergent solution.
- iv) The outer portion of the submersible pump will be rinsed with isopropyl alcohol.

- v) The submersible pump will then be rinsed by submerging in deionized water and allowed to air dry as long as possible prior to use.

Fluids used for cleaning will not be recycled. All wash water, rinse water and decontamination fluids will be stored in containers on Site pending a review of potential disposal options.

H.1.3.2 FIELD SAMPLING

H.1.3.2.1 Sample Labelling

Each sample will be labeled with a unique sample number that will facilitate tracking and cross-referencing of sample information. The sample numbering system is described below:

Example: GW-060191-WP-0001

GW	- designates type of sample (GW-groundwater, SW-surface water, D-sediment)
060191	- designates date of collection presented as month/day/year
WP	- sampler's initials
0001	- sequential number starting with 0001 at the start of the project

Quality Control (QC) samples also will be numbered with a unique sample number, consistent with the numbering system described above.

H.1.3.2.2 Field Log

The field log book will consist of a bound document with consecutively numbered pages. The entries for each day will commence on a new page which will be dated. Corrections will be made by marking through

the error with a single line, so as to remain legible, and initialing this action followed by writing the correction. The field log books generated will be numbered consecutively and maintained by Conestoga-Rovers & Associates (CRA) at the Rosemont, Illinois office.

The following information will be recorded in the field log book for each sample collected:

- i) Site location identification;
- ii) unique sample identification number;
- iii) date and time (in military time format) of sample collection;
- iv) weather conditions;
- v) designation as to the type of sample (groundwater, sediment, etc.);
- vi) designation as to the means of collection (grab, bailer, etc.);
- vii) name of sampler;
- viii) analyses to be performed on sample;
- ix) personal protective equipment (PPE) worn during Site activities;
- x) names of subcontractors and subcontractor personnel; and
- xi) any other relevant comments such as odor, staining, texture, filtering, preservation, etc.

For the abandonment of monitoring wells, the following will be recorded in the field log book:

- i) weather conditions;

CRA

CONESTOGA-ROVERS & ASSOCIATES
10400 West Higgins Road - Suite 103
Rosemont, IL 60018 (708)299-9933

SHIPPED TO (Laboratory Name):

REFERENCE NUMBER:

PROJECT NAME:

CHAIN OF CUSTODY RECORD

SAMPLER'S SIGNATURE: _____ PRINTED NAME: _____

SEQ. No. DATE TIME SAMPLE No.

SAMPLE MATRIX No. OF CONTAINERS

PARAMETERS

REMARKS

SAMPLE

TOTAL NUMBER OF CONTAINERS

RELINQUISHED BY: ①

RELINQUISHED BY: ②

RELINQUISHED BY: ③

RELINQUISHED BY: ④

METHOD OF SHIPMENT:

AIR BILL No.

SAMPLE TEAM:

RECEIVED FOR LABORATORY BY:

White - Fully Executed Copy
Yellow - Receiving Laboratory Copy
Pink - Shipper Copy
Goldenrod - Sampler Copy

DATE: TIME:

figure H.1.1

CRA

CHAIN-OF-CUSTODY RECORD
FOUR COUNTY LANDFILL SITE
Fulton County, Indiana

- ii) date of installation;
- iii) type of drill rig used;
- iv) length of time to abandon the well;
- v) depth of well;
- vi) well abandonment details; and
- vii) subcontractor identity; and
- viii) any other relevant comments.

Well purging details and the results of response tests on monitoring wells will be recorded on CRA standard forms, a copy of which will be kept in CRA's project files.

H.1.3.2.3 Chain-Of-Custody Records

CRA chain-of-custody records will be used to track all samples from time of sampling to the arrival of samples at the laboratory.

Each sample container being shipped to the laboratory will contain a chain-of-custody record. The chain-of-custody record consists of four copies which are distributed to the sampler, to the shipper, to the contract laboratory and to the office file of CRA. The sampler and shipper will maintain their copies while the other two copies are placed in a waterproof enclosure within the sample container. The laboratory, upon receiving the samples, will complete the remaining copies. The laboratory will maintain one copy for its records. The executed original will be returned to CRA with the data deliverables package. A typical chain-of-custody record is presented on Figure H.1.1.

H.1.3.2.4 Sample Containers and Handling

Required sample containers, sample preservation methods, maximum holding times and filling instructions are provided in Table H.1.1 and the QAPP in Appendix H.2.

All samples will be placed in appropriate sample containers, labeled and properly sealed. The sample labels will include sample number, place of collection, date and time of collection and analyses to be performed. Samples will be cushioned within the shipping coolers by the use of vermiculite, foam chips and/or bubble pack. Samples will be kept cool by the use of sealed plastic bags of ice or cooler packs. A trip blank will accompany each shipment of groundwater and surface water samples submitted for VOC analysis.

Samples will be shipped by commercial courier on a daily basis to the project laboratory. The exception to this will be samples which are collected on a Sunday or holiday. For samples collected on a Sunday or holiday, additional ice will be placed in the coolers, the coolers will be sealed and kept under surveillance, and picked up by the courier on the next business day.

Two seals comprised of CRA chain-of-custody tape will be placed over the lid on the front and back of each shipping cooler prior to shipment to secure the lid and provide evidence that the samples have not been tampered with en route to the laboratory. Clear tape will be placed over the seals to ensure that they are not accidentally broken during shipment.

Upon receipt of the cooler at the laboratory, the cooler will be inspected by the designated sample custodian. The condition of the cooler and seal will be noted on the chain-of-custody record by the sample custodian.

The sample custodian then will check the contents of the cooler with those samples listed on the chain-of-custody record. If damage or discrepancies are noticed, they will be recorded in the remarks column of the

TABLE H.1.1

**CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA**

<i>Analyses</i>	<i>Sample Containers</i>	<i>Preservation</i>	<i>Maximum Holding Time from Sample Collection*</i>	<i>Volume of Sample</i>	<i>Shipping</i>	<i>Normal Packaging</i>
<u>Groundwater</u>						
TCDD	Two 1-liter amber glass bottles	Iced, 4 °C	30 days for extraction 45 days after extraction for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
TCL SVOC, Appendix IX SVOC, Appendix IX Pest/PCB, Appendix IX Herbicides	Two 1-liter amber glass bottles per analysis	Iced, 4° C	7 days for extraction 40 days after extraction for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
TCL VOC, Appendix IX VOC	Three 40-mL teflon lined septum vials per analysis	HCl to pH <2, Iced, 4 °C	14 days for analysis	Fill completely, no air bubbles	Federal Express Priority 1	Foam Liner
TAL Total Metals, TAL Dissolved Metals, Appendix IX Metals	One 1-liter plastic bottle per analysis	HNO ₃ to pH <2, Iced, 4 °C	6 months (mercury - 28 days) for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
TAL Cyanide	One 1-liter plastic bottle	NaOH to pH >12, Iced, 4 °C	14 days for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
BOD	One 1-liter polyethylene	Iced, 4 °C	48 hours to incubation	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
Total Suspended Solids, Total Dissolved Solids	One 1-liter polyethylene	Iced, 4 °C	7 days for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
Alkalinity, Chloride, Sulfate	One 1-liter polyethylene	Iced, 4 °C	28 days (Alkalinity 14 days) for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips

TABLE H.1.1

**CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA**

<i>Analyses</i>	<i>Sample Containers</i>	<i>Preservation</i>	<i>Maximum Holding Time from Sample Collection*</i>	<i>Volume of Sample</i>	<i>Shipping</i>	<i>Normal Packaging</i>
Ammonia, Nitrate, COD	One 1-liter polyethylene	H ₂ SO ₄ to pH<2 Iced, 4 °C	28 days for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
<u>Sediment</u>						
TCL SVOC, TCL Pesticides/PCB	One 8-ounce glass per analysis	Iced, 4 °C	14 days for extraction 40 days after extraction for analysis	Fill to shoulder of jar	Federal Express Priority 1	Bubble Wrap or Foam Chips
TCL VOC	One 4-ounce glass	Iced, 4 °C	14 days for analysis	Fill completely	Federal Express Priority 1	Bubble Wrap or Foam Chips
TAL Metals	One 16-ounce glass	Iced, 4 °C	6 months (mercury - 28 days) for analysis	Fill to shoulder of jar	Federal Express Priority 1	Bubble Wrap or Foam Chips
TAL Cyanide	No additional jar necessary	Iced, 4 °C	14 days for analysis	Fill to shoulder of jar	Federal Express Priority 1	Bubble Wrap or Foam Chips
TOC	One 4-ounce glass	Iced, 4 °C	28 days for analysis	Fill to shoulder of jar	Federal Express Priority 1	Bubble Wrap or Foam Chips
<u>Surface Water</u>						
TCL SVOC, TCL Pesticides/PCB	Two 1-liter amber glass bottles per analysis	Iced, 4 °C	7 days for extraction 40 days after extraction for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
TCL VOC	Three 40-mL teflon lined septum vials	HCl to pH <2, Iced, 4 °C	14 days for analysis	Fill completely, no air bubbles	Federal Express Priority 1	Foam Liner
TAL Metals	One 1-liter plastic bottle	HNO ₃ to pH <2, Iced, 4 °C	6 months (mercury - 28 days) for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
TAL Cyanide	One 1-liter plastic bottle	NaOH to pH >12, Iced, 4 °C	14 days for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips

TABLE H.1.1

**CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA**

<i>Analyses</i>	<i>Sample Containers</i>	<i>Preservation</i>	<i>Maximum Holding Time from Sample Collection*</i>	<i>Volume of Sample</i>	<i>Shipping</i>	<i>Normal Packaging</i>
<u><i>Air</i></u>						
VOC	6-liter Summa® Passivated Canister	None	14 days for analysis	Not Applicable	Federal Express Priority 1	Cannister Container

* - These are technical holding times; (i.e., are based on time elapsed from time of sample collection).

chain-of-custody record, dated and signed. They will be reported to the laboratory supervisor who will inform the laboratory project manager and QC officer.

H.1.4.0 FIELD PROTOCOLS

In order to meet the objectives of the RI/FS at the Four County Landfill Site, the following field activities will be implemented:

- i) inspection of all accessible existing Site monitoring wells;
- ii) collection of groundwater samples for chemical analysis from 71 existing Site monitoring wells and piezometers;
- iii) abandonment of 20 existing Site monitoring wells with excessively long effective screen lengths and improper construction specifications;
- iv) collection of on- and off-Site sediment and surface water samples for chemical analysis; and
- v) collection of hydraulic head and response test data.

Sediment, surface water and groundwater sampling protocols are discussed in Section H.1.5.0. Protocols for general field tasks are discussed below. Monitoring well locations are provided in Figure H.1.2.

H.1.4.1 MONITORING WELL AND PIEZOMETER INSPECTION

A large number of monitoring wells and piezometers (approximately 118) are known to have been installed at the Site. Therefore, prior to initiation of monitoring well/piezometer abandonment activities, a thorough inventory and inspection of all existing Site monitoring wells and piezometers will be conducted. Each Site monitoring well/piezometer will be carefully inspected and the information recorded on the standard CRA monitoring well inspection checklist.

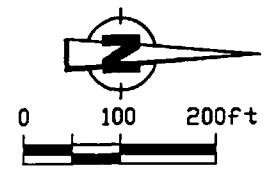
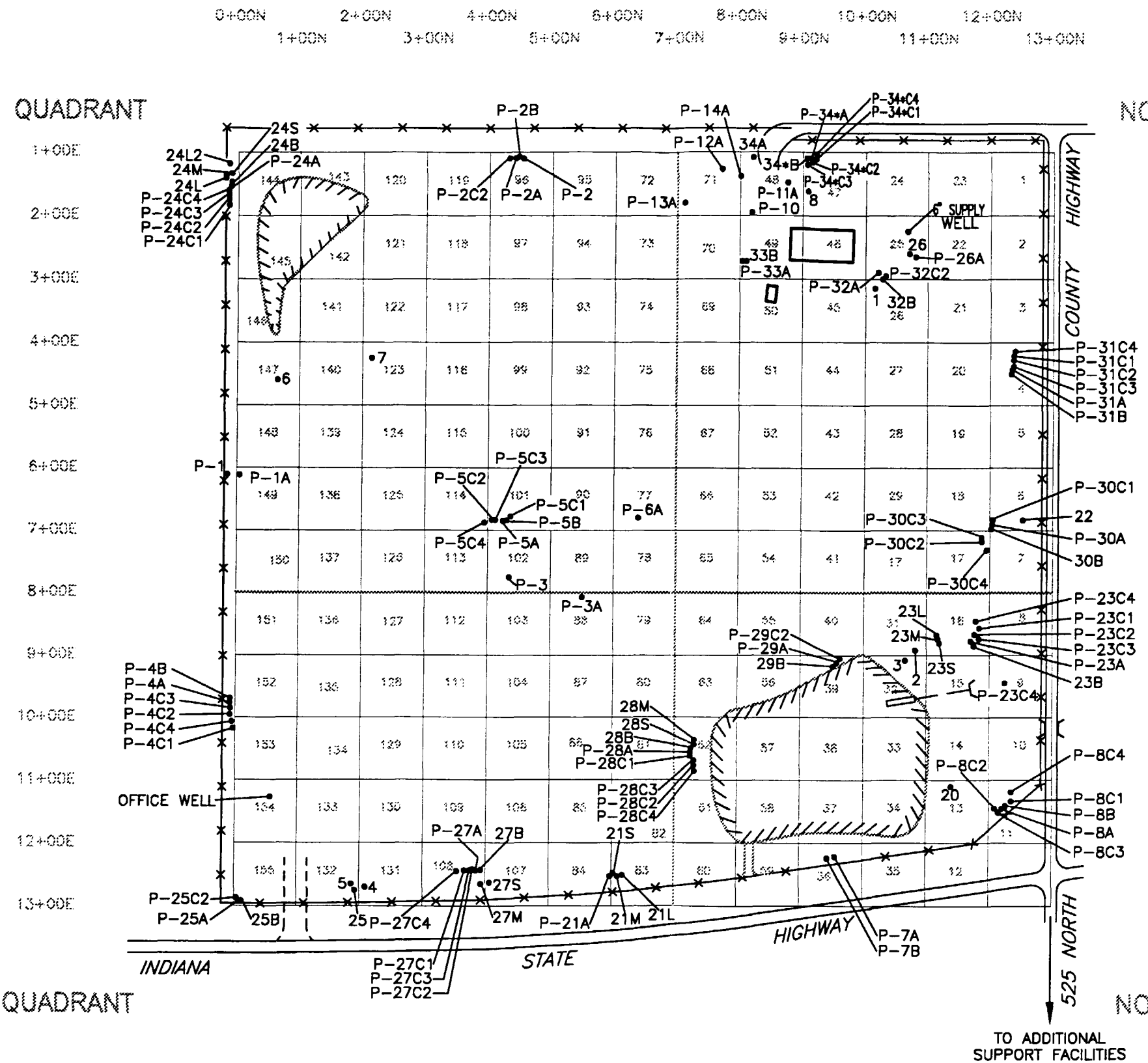
The identity of each monitoring well/piezometer will be confirmed by comparing data recorded during the inspection with available

SOUTHWEST QUADRANT

NORTHWEST QUADRANT

SOUTHEAST QUADRANT

NORTHEAST QUADRANT



SOURCE:
MODIFICATION OF A SITE MAP (4/15/91)
OBTAINED FROM
GEOSCIENCES RESEARCH
ASSOCIATES, INC.

LEGEND

- 155 BLOCK NUMBERS OF GRID
- P-30C1 PIEZOMETERS
- 22 MONITORING WELLS
- x— FENCE LINE

NOTE
SITE GRID = 100 FEET.

figure H.1.2
MONITORING WELL LOCATIONS
FOUR COUNTY LANDFILL SITE
Fulton County, Indiana

well records, Site maps, and identification marks present. Monitoring wells and piezometers slated for abandonment will be marked with flagging tape.

On the basis of the detailed field inspection, additional monitoring wells and piezometers may be identified for abandonment. Recommendations and justifications for abandonment of additional monitoring wells will be presented to IDEM. IDEM will be contacted for approval to abandon additional monitoring wells or piezometers. Specific situations which may occur that may result in a monitoring well or piezometer being identified for abandonment include:

- i) depth measurements which vary considerably from data recorded in well logs that may indicate damage or plugging of the well/piezometer; and
- ii) damaged casings which may compromise the integrity or prevent collection of a groundwater sample from a well/piezometer.

Should these or other situations occur which prevent the collection of, or compromise the integrity of groundwater samples from a specific monitoring well or piezometer, this situation will be documented by CRA. IDEM will be contacted regarding the specifics of this situation and CRA's recommendation for abandonment. Appropriate action will then be initiated following this discussion. A summary of monitoring well and piezometer construction data is presented on Table H.1.2.

H.1.4.2 MONITORING WELL/PIEZOMETER ABANDONMENTS

Monitoring wells and piezometers with excessively long effective screen lengths, inappropriate construction specifications, or providing redundant monitoring of a specific stratigraphic unit will be properly abandoned to minimize cross-contamination between geologic units. Table H.1.3 provides a summary of monitoring wells and piezometers which will be abandoned.

TABLE H.1.2

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA¹
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

<i>Piezometer/ Well ID</i>	<i>Stratigraphic Unit(s) Screened</i>	<i>Former/ Other ID²</i>	<i>Casing Elevation (feet amsl)</i>	<i>Site Quadrant³</i>	<i>Date of Installation</i>	<i>Well Depth (feet bgs)/ Bottom Elevation (feet amsl)</i>	<i>Screen Length (feet)</i>	<i>Sand Pack Length (feet)</i>	<i>Well Construction Details⁴</i>	<i>Comments</i>
P-1	B	MW-1B	783.07	SW	12/08/86	65.0/718.1	5	13.0	hand slotted PVC, 1" dia., 3.75" dia. borehole,	
P-1A	A	--	787.64	SW	12/05/88	37.1/749.2	2	2.7	4.25" dia. borehole, 2' bentonite seal, ⁵	
P-2	B	--	777.55	SW	12/15/86	80.0/697.9	10	12.0	hand slotted PVC, 1" dia., 7.25" dia. borehole,	
									8' bentonite seal	
P-2A	A	--	777.38	SW	12/05/88	17.0/758.0	2	2.6	4.25" dia. borehole, 3' bentonite seal, ⁵	
P-2B	B	MW-2B	777.05	SW	12/05/88	72.2/702.7	4	6.4	4.25" dia. borehole, 7.8' bentonite seal, ⁵	
P-2C2	C	--	776.86	SW	12/09/89	134.9/639.8	2	5.5	4.9" dia. borehole, no bentonite seal, ⁵	
P-3	B?	--	772.71	SW	12/10/86	50.9/715.4	5	18.9	hand slotted PVC, 1" dia., 3.75" dia. borehole,	Assume casing removed
									2' bentonite seal	12/19/86.
P-3A	A?	--	766.22	SE	unknown	unknown	unknown	unknown	unknown	Assume casing removed
										during Cell B construction.
P-4A	A	--	790.03	SE	11/07/88	19.0/769.1	2	2.8	4.25" dia. borehole, 2' bentonite seal, ⁵	
P-4B	B	--	790.00	SE	11/04/88	69.6/718.6	2	6.4	4.25" dia. borehole, 2.7' bentonite seal, ⁵	
P-4C1	C	--	791.02	SE	01/04/89	85.6/703.9	2	4.0	4.9" dia. borehole, no bentonite seal, ⁵	
P-4C2	C	--	791.72	SE	01/03/89	132.9/656.7	2	4.0	4.9" dia. borehole, no bentonite seal, ⁵	
P-4C3	C	--	791.71	SE	02/02/89	155.6/633.9	2	4.5	4.9" dia. borehole, no bentonite seal, ⁵	
P-4C4	C	--	791.02	SE	01/27/89	152.5/637.0	2	4.0	Schedule 80 PVC, 4.9" dia. borehole,	
									no bentonite seal, ⁵	
P-5A	A/B?	--	776.93	SW	11/08/88	28.1/746.3	2	4?	4.25" dia. borehole, 2' bentonite seal, ⁵	
P-5B	B	MW-5B	776.86	SW	11/03/88	49.1/725.0	2	6.1	4.25" dia. borehole, 2' bentonite seal, ⁵	
P-5C1	C	--	776.63	SW	01/12/89	77.1/696.6	2	3.0	4.5" dia. borehole, no bentonite seal, ⁵	
P-5C2	C	--	777.29	SW	01/18/89	107.4/666.9	2	4.0	4.9" dia. borehole, 2' bentonite seal, ⁵	
P-5C3	C	--	777.05	SW	01/18/89	119.8/654.5	2	2.8	4.25" dia. borehole, 2' bentonite seal, ⁵	
P-5C4	C	--	777.23	SW	01/29/89	166.2/608.3	2	5.0	Schedule 80 PVC, 4.9" dia. borehole,	
									no bentonite seal, ⁵	

TABLE H.1.2

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA¹
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

<i>Piezometer/ Well ID</i>	<i>Stratigraphic Unit(s) Screened</i>	<i>Former/ Other ID²</i>	<i>Casing Elevation (feet amsl)</i>	<i>Site Quadrant³</i>	<i>Date of Installation</i>	<i>Well Depth (feet bgs)/ Bottom Elevation (feet amsl)</i>	<i>Screen Length (feet)</i>	<i>Sand Pack Length (feet)</i>	<i>Well Construction Details⁴</i>	<i>Comments</i>
P-6A	A		776.57	SW	11/01/88	21.0/752.9	2	3.0	4.25" dia. borehole, 2.1' bentonite seal,	⁶
P-7A	B	--	771.24	NE	11/18/88	21.4/748.0	2	2.7	4.25" dia. borehole, 2' bentonite seal,	⁵
P-7B	B	MW-7B	770.92	NE	11/17/88	50.9/718.4	5	6.0	4.25" dia. borehole, 2' bentonite seal,	⁵
P-8A	A	--	757.70	NE	11/23/88	19.9/735.4	2	3.9	4.25" dia. borehole, 2' bentonite seal,	⁵
P-8B	B	MW-8B	756.99	NE	11/02/88	47.9/707.2	4	5.5	4.25" dia. borehole, 6' bentonite seal,	⁵
P-8C1	C	--	757.71	NE	01/25/89	79.8/675.3	2	3.8	5.25" dia. borehole, no bentonite seal,	⁵
P-8C2	C	--	757.68	NE	01/27/89	113.0/642.8	2	4.0	4" dia. borehole, no bentonite seal,	⁵
P-8C3	C	--	757.34	NE	01/26/89	133.5/622.1	2	4.5	4.75" dia. borehole, no bentonite seal,	⁵
P-8C4	C	MW-8C4	757.68	NE	01/03/89	180.5/575.3	2	5.4	Schedule 80 PVC, 5.75" dia. borehole, no bentonite seal,	⁵
P-10	A	P-10A	797.05	NW	11/18/88	14.5/779.4	2	2.8	4.25" dia. borehole, 2' bentonite seal,	⁵
P-11A	A	--	796.20	NW	11/21/88	13.5/780.6	2	3.2	4.25" dia. borehole, 2' bentonite seal,	⁵
P-12A	A	--	796.90	NW	11/16/89	19.6/774.2	2	3.0	3.25" dia. borehole, 0.5' bentonite seal,	⁵
P-13A	A	--	799.94	NW	11/17/89	21.6/775.2	4	6.0	3.25" dia. borehole, 1' bentonite seal, screened in refuse,	⁵
P-14A	A	--	797.72	NW	11/20/89	21.5/773.2	4	5.5	3.25" dia. borehole, 1' bentonite seal,	⁵
P-21A	A	MW-21A	776.50	SE	11/09/88	22.3/752.2	2	2.8	4.25" dia. borehole, 2' bentonite seal,	⁵
P-23A	A	MW-23A	760.15	NE	11/23/88	19.3/738.5	2	3.3	4.25" dia. borehole, 2' bentonite seal,	⁵
P-23C1	C	--	761.08	NE	01/13/89	77.7/680.4	2	5.9	4.75" dia. borehole, no bentonite seal,	⁵
P-23C2	C	--	761.15	NE	01/12/89	116.1/642.0	2	3.7	4.75" dia. borehole, no bentonite seal,	⁵
P-23C3	C	--	760.83	NE	01/12/89	136.5/621.1	2	3.9	4.75" dia. borehole, no bentonite seal,	⁵
P-23C4	C	--	760.03	NE	01/18/89	177.7/580.5	2	4.5	Schedule 80 PVC, 5.75" dia. borehole, no bentonite seal,	⁵
P-24A	A	MW-24A	788.29	SW	12/04/88	28.8/757.5	2	2.7	4.25" dia. borehole, 2' bentonite seal,	⁵
P-24C1	C	--	788.32	SW	01/19/89	89.9/696.2	2	4.4	4.75" dia. borehole, no bentonite seal,	⁵
P-24C2	C	--	787.90	SW	01/18/89	104.9/681.2	2	3.2	4.75" dia. borehole, no bentonite seal,	⁵
P-24C3	C	--	788.51	SW	01/17/89	119.1/666.9	2	4.5	4.75" dia. borehole, no bentonite seal,	⁵
P-24C4	C	--	788.43	SW	01/16/89	131.2/654.9	2	4.4	Schedule 80 PVC, 4.75" dia. borehole, no bentonite seal,	⁵

TABLE H.1.2

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA¹
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

<i>Piezometer/ Well ID</i>	<i>Stratigraphic Unit(s) Screened</i>	<i>Former/ Other ID²</i>	<i>Casing Elevation (feet amsl)</i>	<i>Site Quadrant³</i>	<i>Date of Installation</i>	<i>Well Depth (feet bgs)/ Bottom Elevation (feet amsl)</i>	<i>Screen Length (feet)</i>	<i>Sand Pack Length (feet)</i>	<i>Well Construction Details⁴</i>	<i>Comments</i>
P-25A	A	MW-25A	793.83	SE	12/06/88	32.2/759.9	2	3.0	4.25" dia. borehole, 2.3' bentonite seal,	⁵
P-25C2	C	--	794.86	SE	01/20/89	122.0/670.4	2	4.0	4.75" dia. borehole, no bentonite seal,	⁵
P-26A	A	--	792.32	NW	11/21/89	13.9/775.3	3.5	3.7	3.25" dia. borehole, 0.5' bentonite seal,	⁵
P-27A	A	MW-27A	780.32	SE	12/01/88	17.0/761.6	2	3.5	4.25" dia. borehole, 2' bentonite seal,	⁵
P-27C1	C	--	780.42	SE	01/13/89	79.3/699.8	2	4.0	4.75" dia. borehole, no bentonite seal,	⁵
P-27C2	C	--	780.10	SE	01/10/89	109.3/669.4	2	5.0	4" dia. borehole, no bentonite seal,	⁵
P-27C3	C	--	780.10	SE	01/12/89	130.3/648.4	2	6.0	4.25" dia. borehole, no bentonite seal,	⁵
P-27C4	C	--	781.96	SE	01/17/89	18.7/599.5	2	4.5	Schedule 80 PVC, 4.75" dia. borehole, no bentonite seal,	⁵
P-28A	A	MW-28A	775.37	NE	11/28/88	26.1/748.2	2	3.0	4.25" dia. borehole, 2' bentonite seal,	⁵
P-28C1	CB	--	777.05	NE	01/16/89	85.0/689.4	2	3.2	4.25" dia. borehole, no bentonite seal,	⁵
P-28C2	C	--	776.35	NE	01/26/89	121.9/652.2	2	4.5	Schedule 80 PVC, 4.75" dia. borehole, no bentonite seal,	⁵
P-28C3	C	--	776.79	NE	01/26/89	135.1/639.1	2	6.0	4.75" dia. borehole, no bentonite seal,	⁵
P-28C4	C	--	776.50	NE	01/25/89	201.8/572.3	2	7.0	Schedule 80 PVC, 4.75" dia. borehole, no bentonite seal,	⁵
P-29A	A	MW-29A	773.78	NE	11/30/88	13.5/758.1	2	2.4	4.25" dia. borehole, 4' bentonite seal,	⁵
P-29C2	C	--	772.92	NE	01/18/89	116.2/655.4	2	4.9	4" dia. borehole, no bentonite seal,	⁵
P-30A	A	MW-30A	761.97	NW	11/22/88	20.4/739.6	2	2.9	4.25" dia. borehole, 2.5' bentonite seal,	⁵
P-30C1	C	--	762.56	NW	01/23/89	59.8/700.0	2	4.3	4" dia. borehole, no bentonite seal,	⁵
P-30C2	C	--	764.02	NW	01/31/89	102.4/659.2	2	4.5	4.75" dia. borehole, no bentonite seal,	⁵
P-30C3	C	--	764.37	NW	01/30/89	122.4/639.1	2	4.2	4.75" dia. borehole, no bentonite seal,	⁵
P-30C4	C	--	762.87	NW	01/19/89	219.8/541.0	2	10.3	Schedule 80 PVC, 4.75" dia. borehole, no bentonite seal, (5)	

TABLE H.1.2

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA¹
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

<i>Piezometer/ Well ID</i>	<i>Stratigraphic Unit(s) Screened</i>	<i>Former/ Other ID²</i>	<i>Casing Elevation (feet amsl)</i>	<i>Site Quadrant³</i>	<i>Date of Installation</i>	<i>Well Depth (feet bgs)/ Bottom Elevation (feet amsl)</i>	<i>Screen Length (feet)</i>	<i>Sand Pack Length (feet)</i>	<i>Well Construction Details⁴</i>	<i>Comments</i>
P-31A	A	MW-31A	783.02	NW	11/29/88	14.9/765.7	2	2.9	4.25" dia. borehole, 2' bentonite seal, ⁵	
P-31C1	C	--	782.78	NW	01/10/89	86.7/694.0	2	2.6	4.75" dia. borehole, no bentonite seal, ⁵	
P-31C2	C	--	782.60	NW	01/09/89	111.6/669.1	2	2.5	4.75" dia. borehole, no bentonite seal, ⁵	
P-31C3	C	--	782.75	NW	01/06/89	134.2/646.5	2	3.5	4" dia. borehole, no bentonite seal, ⁵	
P-31C4	C	--	782.77	NW	01/17/89	194.1/586.5	2	3.4	Schedule 80 PVC, 4.75" dia. borehole, no bentonite seal, ⁵	
P-32A	A	--	798.53	NW	11/22/89	18.1/777.7	4.5	5.0	3.25" dia. borehole, 0.3' bentonite seal, ⁵	
P-32C2	C	--	797.84	NW	01/13/89	130.8/665.0	2	2.8	4.75" dia. borehole, no bentonite seal, ⁵	
P-33A	A	MW-33A	798.06	NW	11/11/88	20.0/775.2	2	3.1	4.25" dia. borehole, 2' bentonite seal, ⁵	
P-34A	A	MW-34A	794.73	NW	10/11/88	18.8/772.8	2	2.7	4.25" dia. borehole, 2' bentonite seal, ⁵	Drilled through refuse. Removed 11/07/89. Now a sump.
P-34*A	A	MW-34*A	796.01	NW	12/07/88	26.0/767.9	1.3	3.0	4.25" dia. borehole, 2' bentonite seal, ⁵	
P-34*C1	C	--	796.16	NW	01/10/89	97.7/696.4	2	2.7	4.25" dia. borehole, no bentonite seal, ⁵	
P-34*C2	C	--	795.88	NW	01/12/89	126.6/667.3	2	4.0	4.75" dia. borehole, no bentonite seal, ⁵	
P-34*C3	C	--	796.27	NW	01/11/89	149.8/644.1	2	3.8	4.75" dia. borehole, no bentonite seal, ⁵	
P-34*C4	C	--	796.29	NW	01/11/89	193.7/600.3	2	3.7	Schedule 80 PVC, 4.75" dia. borehole, no bentonite seal, ⁵	
MW-1	A/B?	W-1	790.61	NW	12/26/78	42/749	2	unknown	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout	Buried?
MW-2	A	W-2	769.88	NE	12/26/78	20/750	2	unknown	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout	Not accessible ?
MW-3	A?	W-3	771.57	NE	12/27/78	38/732	2	unknown	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout	
MW-4	A	W-4	786.24	SE	02/20/79	19/?	??	unknown	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout	Disturbed, casing broken.

TABLE II.1.2

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA¹
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

<i>Piezometer/ Well ID</i>	<i>Stratigraphic Unit(s) Screened</i>	<i>Former/ Other ID²</i>	<i>Casing Elevation (feet amsl)</i>	<i>Site Quadrant³</i>	<i>Date of Installation</i>	<i>Well Depth (feet bgs)/ Bottom Elevation (feet amsl)</i>	<i>Screen Length (feet)</i>	<i>Sand Pack Length (feet)</i>	<i>Well Construction Details⁴</i>	<i>Comments</i>
MW-5	B	W-5	789.23	SE	02/20/79	35/740	2	unknown	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout	
MW-6	A/B?	W-6	780.63	SW	01/03/79	51/724	2	unknown	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout	Formerly buried.
MW-7	B?	W-7	776.87	SW	12/29/78	36/737	2	unknown	4" dia. casing, glued joints, 25-slot screen, no bentonite seal or grout	Casing raised ~3.5 Not accessible. Buried?
MW-8	B/C?	W-8	unknown	NW	unknown	unknown	unknown	unknown	unknown	Former residential well. Buried?
MW-20	A/B?	W-20	767.23	NE	05/19/83	45.5/721.7	15	17.5	4" dia. PVC, 10.5" dia. borehole, 2' bentonite seal	Possible grout contamination.
MW-21S	B	W-21, MW021	778.00	SE	05/27/83	60.0/718.0	15	20.0	4" dia. PVC, 10.5" dia. borehole, 2' bentonite seal	
MW-21M	C	--	777.37	SE	01/27/87	94.8/682.5	10	18.3	4.25" dia. borehole, 11.5' bentonite seal	
MW-21L	C	--	777.01	SE	01/20/87	212.0/565.0	10	14.0	4.25" dia. borehole, 5' bentonite seal	
MW-22	B	--	757.17	NW	06/01/83	38.5/718.7	15	14.5	4" dia. PVC, 10.5" dia. borehole, 2' bentonite seal	
MW-23B	B	MW-23BW	759.84	NE	11/22/88	39.4/718.2	5	7.0	4.5" dia. borehole, 2' bentonite seal	
MW-23S	A/B	--	765.41	NE	04/08/85	48.0/717.4	20	24.0	6.5" dia. borehole	
MW-23M	A/B/C	--	765.46	NE	04/08/85	85.5/680.0	20	69.5	6.5" dia. borehole, 1' bentonite seal	
MW-23L	B/C	MW-23D	765.50	NE	04/08/85	122.0/643.5	20	92.0	6.5" dia. borehole, 1' bentonite seal	
MW-24B	B	P-24B	787.70	SW	12/04/88	74.2/711.9	5	7.0	4.5" dia. borehole, 2' bentonite seal ⁵	
MW-24S	C	P-24S	789.66	SW	12/05/86	75.0/714.7	10	19.0	7.25" dia. borehole, 5' bentonite seal	
MW-24M	B/C	P-24M	788.96	SW	01/26/87	108.5/680.5	10	28.5	4.5" dia. borehole, 5' bentonite seal	

TABLE H.1.2

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA¹
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

<i>Piezometer/ Well ID</i>	<i>Stratigraphic Unit(s) Screened</i>	<i>Former/ Other ID²</i>	<i>Casing Elevation (feet amsl)</i>	<i>Site Quadrant³</i>	<i>Date of Installation</i>	<i>Well Depth (feet bgs)/ Bottom Elevation (feet amsl)</i>	<i>Screen Length (feet)</i>	<i>Sand Pack Length (feet)</i>	<i>Well Construction Details⁴</i>	<i>Comments</i>
MW-24L	C/D	MW-24L1, P-24L	788.86	SW	01/22/87	142.8/646.0	10	22.8	4.5" dia. borehole, 5' bentonite seal	Abandoned, not plugged. High pH-grout? Replaced.
MW-24L2	C	MW-24L1, P-24L2	788.65	SW	4/87, 5/87	136.0/652.6	10	36.0	Schedule 80 PVC, 4.5" dia. borehole, 56' bentonite seal	
MW-25	A/B	OW-25	789.96	SE	12/17/86	74.0/716.0	10	38.0	7.25" dia. borehole, 5' bentonite seal	Possible grout contamination.
MW-25B	B/C?	MW-25BW,	793.81	SE	12/07/88	78.5/713.7	5	6.5	4.5" dia. borehole, 2' bentonite seal,	
MW-26	B	OW-26	791.40	NW	01/06/87	77.2/14.2	10	16.7	4.5" dia. borehole, 5.5' bentonite seal	
MW-27B	B	MW-27BW	779.76	SE	12/01/88	55.0/723.2	5	7.0	4.25" dia. borehole, 2.5' bentonite seal,	
MW-27S	B/C	--	778.95	SE	04/29/87	72.0/707.0	10	34.0	4.5" dia. borehole, 9.3' bentonite seal,	
MW-27M	B/C	--	779.44	SE	04/29/87	101.4/678.0	5	48.4	4.5" dia. borehole, 10' bentonite seal,	
MW-28B	B	MW-28BW	775.64	NE	11/28/88	60.0/713.7	10	6.8	4.25" dia. borehole, 2' bentonite seal,	
MW-28S	A/B	--	775.71	NE	05/04/87	60.5/715.2	5	17.5	4.5" dia. borehole, 10' bentonite seal,	
MW-28M	B/C	--	776.20	NE	05/01/87	101.1/675.2	10	28.0	4.5" dia. borehole, 5' bentonite seal,	
MW-29B	B	MW-29BW	773.43	NE	11/30/88	51.9/719.3	10	7.4	4.25" dia. borehole, 9.8' bentonite seal,	
MW-30B	B	MW-30BW	462.02	NW	11/21/88	42.2/718.8	5	8.2	4.25" dia. borehole, 4' bentonite seal,	
MW-31B	B	MW-31BW	782.99	NW	11/29/88	61.9/719.0	5	6.9	4.5" dia. borehole, 3' bentonite seal,	
MW-32B	B	P-32B,	798.89	NW	11/14/88	78.0/718.4	5	8.0	4.5" dia. borehole, 2' bentonite seal,	
MW-33B	B	MW-33BW	796.57	NW	11/10/88	725./722.2	5	8.5	4.25" dia. borehole, 12' bentonite seal,	
MW-34*B	B	MW-34B	796.15	NW	12/06/88	74.9/719.2	4.2	6.2	4.25" dia. borehole, 2' bentonite seal,	
6" Diameter Supply Well	B/C?	unknown	796.78	NW	unknown	unknown	unknown	unknown	unknown	
Former Support Facilities (Trailer Well)	unknown	unknown	unknown	SE	unknown	unknown	unknown	unknown	unknown	

TABLE H.1.2

SUMMARY OF MONITORING WELL AND PIEZOMETER DATA¹
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

¹ This monitoring well and piezometer summary was derived from data tables and well construction logs included in the following sources:

- Site Map (4/15/91) obtained from Geosciences Research Associates, Inc.;
- "CAI" Task I - Description of Current Conditions", Geosciences Research Associates, Inc. (12/7/89);
- Memorandum Report, Geosciences Research Associates, Inc. (4/28/89); and
- "Hazardous Waste Groundwater Task Force Evaluation of the Four County Landfill, Fulton County, IN", USEPA, May 1987.

² Stratigraphic units are defined as follows:

- A = Glacial till sequence, silty clay loam with silt and sand seams;
- B = Glacio-lacustrine sequence, silt to fine- to medium-grained sand;
- C = Glacio fluvial sequence, poorly sorted silt, sand, and gravel; and
- D = Basal till, silty clay with reddish hue at base.

³ Site quadrants are arbitrarily defined by the 7+00 North and 8+00 East survey grid lines.

⁴ Well materials are assumed to be 2-inch diameter, threaded, Schedule 40 PVC with a 10-slot screen, unless otherwise noted.

⁵ Well annulus filled with Volclay grout from filter pack or annular seal to surface.

⁶ Well annulus filled with pea gravel and bentonite grout from filter pack or annular seal to surface.

Key:

- amsl = Above mean sea level
- bgs = Below ground surface
- dia. = Diameter
- unknown = Information incomplete or unavailable
- = Not applicable

TABLE H.1.3

GROUNDWATER MONITORING WELLS AND
PIEZOMETERS TO BE ABANDONED
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Northwest Quadrant

MW-1
MW-8

Total = 2

Northeast Quadrant

MW-2
MW-3
MW-20
MW-23S
MW-23M
MW-23L
MW-28S
MW-28M

Total = 8

Southwest Quadrant

MW-6
MW-7
MW-24M
P-2

Total = 4

Southeast Quadrant

MW-4
MW-5
MW-25
MW-27S
MW-27M
P-4C4

Total = 6

Total - All Quadrants = 20

Abandonments will be accomplished using the following procedure:

- i) The protective casing and cement pads will be removed from the ground and the diameter of the well casing will be noted.
- ii) The well cap will be removed and the breathing zone will be monitored with a photoionization detector, combustible gas meter, a hydrogen cyanide meter and a hydrogen sulfide meter. Detections will be recorded in the field log.
- iii) The monitoring well/piezometer will be overdrilled using a 6-inch nominal diameter (2-inch or smaller diameter wells) or an 8-inch nominal diameter (4-inch diameter wells) tricone roller bit and mud rotary drilling methods. The drilling fluid will consist of Volclay or equivalent and mixed to a minimum density of 9.4 pounds per gallon.
- iv) Upon reaching a depth of one foot below the measured total depth of the well, borehole advancement will cease and drilling rods will be removed from the borehole.
- v) A tremie pipe will then be lowered into the borehole and a bentonite grout mixture will be pumped into the borehole to top off the drilling mud.
- vi) Grouting of the borehole will proceed until undiluted grout returns to within five feet of the surface.
- vii) The borehole will be topped off with concrete to the surface.

In the event a drill rig cannot be moved into position to abandon a monitoring well or piezometer or the construction of a monitoring well prohibits abandonment using the procedure described above, the following procedure will be utilized for well abandonments:

- i) The protective casing and cement pads and the breathing zone will be monitored as described in i) and ii) above.
- ii) The monitoring well will be grouted using a bentonite grout mixture pumped to within five feet of the surface as described in v) above.
- iii) The well casing will be cut off at grade.
- iv) The remainder of the annular space will then be filled with a cement-bentonite grout mixture to the surface.

Available records indicate that MW-8 may be buried. In the event MW-8 cannot be located by visual inspection, a magnetometer will be used to identify a likely location for this well since it is constructed of iron pipe. A test excavation may then be required to positively locate this well.

H.1.4.3 HYDRAULIC DATA

H.1.4.3.1 Response Test

In situ testing will be completed to determine the hydrogeologic properties of the various stratigraphic units. Single well response tests will be performed on selected monitoring wells presented on Table H.1.4. These tests involve changing the water level within a well and monitoring the time required for the level to return to the static position. Two types of response tests are normally performed, namely: falling head tests, where a slug of known volume is introduced into the standing water column; and rising head test, where a known volume of water is removed from the well and the recovery is monitored.

The displacement of the water level will be accomplished by means of a "slug" consisting of a 1 1/2-inch diameter aluminum rod three feet in length. Alternatively, water displacement may be accomplished by removing a known volume of water from the well. The water level will be

TABLE H.1.4

RESPONSE TEST LOCATIONS
FOUR COUNTY LANDFILL
FULTON COUNTY, INDIANA

<i>Monitoring Well/ Piezometer ID#</i>	<i>Quadrant Location</i>	<i>Screened Interval (ft amsl)</i> ¹	<i>Stratigraphic Unit</i>
P-29C2	NE	657.4 to 655.4	C
MW-29B	NE	729.3 to 719.3	B
MW-31B	NW	724.0 to 719.0	B
P-34*C3	NW	602.3 to 600.3	C
P-27C2	SE	671.4 to 669.4	C
P-4B	SE	720.6 to 718.6	B
P-5C4	SW	610.3 to 608.3	C
MW-24B	SW	716.9 to 711.9	B

¹ Screened interval measured in feet above mean sea level (ft amsl) datum.

Key: amsl = Above mean sea level

monitored with a downhole pressure transducer and a data logger until it returns to the static level. The slug and water level measuring device will be decontaminated between wells as specified in the cleaning protocols presented in Section H.1.4.1.

Several methods have been developed for determination of hydraulic conductivity values from response test data. These methods consider well construction, hydrogeological setting, and time lag response as factors to calculate in situ hydraulic conductivity. The method of Hvorslev (1951) will be used if possible, to analyze the results of response tests. If this method is found not to be applicable, other methods which may be employed include Copper *et al.* (1967), Papadopoulos *et al.* (1973), and Bouwer and Rice (1976), and Nguyen-Pinder (1984). The method selected for calculation of the hydraulic conductivity will be presented in the RI report.

H.1.4.3.2 Hydraulic Monitoring

Before purging and sampling, the water level in each monitoring well will be measured using an electronic sounding device. Water levels will be recorded in the field log book to the nearest 0.01 foot. Measuring devices will be cleaned after each use as specified in the cleaning protocols presented in Section H.1.4.1. Water levels will be measured in both new and existing monitoring wells with an electronic water level meter.

Hydraulic monitoring will be performed in accordance with the procedure outlined below:

- i) Prior to conducting hydraulic monitoring at each location, electronic water level meters will be precleaned in accordance with the protocol outlined in Section H.1.3.1.
- ii) The well cap will be removed and air in the breathing zone will be monitored using a photoionization detector, a combustible gas meter, a combination gas meter (O₂, CO₂, CO and H₂S) and a hydrogen cyanide gas meter in accordance with the HSP in

Appendix. Samples will then don appropriate PPE consisting, at a minimum, of disposal nitrile or latex gloves.

- iii) The water level meter will be self-tested and then lowered gently into the well casing. Water level meter will produce an audible and visual alarm upon encountering water within the well casing. Sampler will gently raise and lower the probe to confirm that water has been encountered.
- iv) The depth to water will then be read to the nearest 0.01 foot from the top of the casing at each location. If there is a survey mark on the well casing, the depth to water will be read from that point. In the event there is no survey mark, the depth to water will be read from the north side of each well casing.
- v) Depth to water level readings will be recorded in the field book. Water level tape will be removed from the well and cleaned prior to use at another location.

H.1.5.0 SAMPLING PROTOCOLS

H.1.5.1 SEDIMENT AND SURFACE WATER

Eight on-Site and 12 off-Site sediment and surface water sampling points have been identified as presented in Figures H.1.3 and H.1.4, respectively. Sediment and surface water sampling locations are approximate only. Actual sampling locations will be strategically located to be near the centerline of drainageways or swales and localized depressions or where standing water is present. Collected sediment and surface water samples will be analyzed for TCL VOC, TCL SVOC, TCL pesticides/PCB, TAL metals and total cyanide. Sediment samples will also be analyzed for TOC.

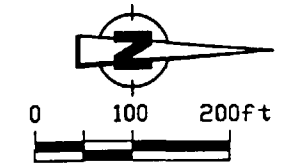
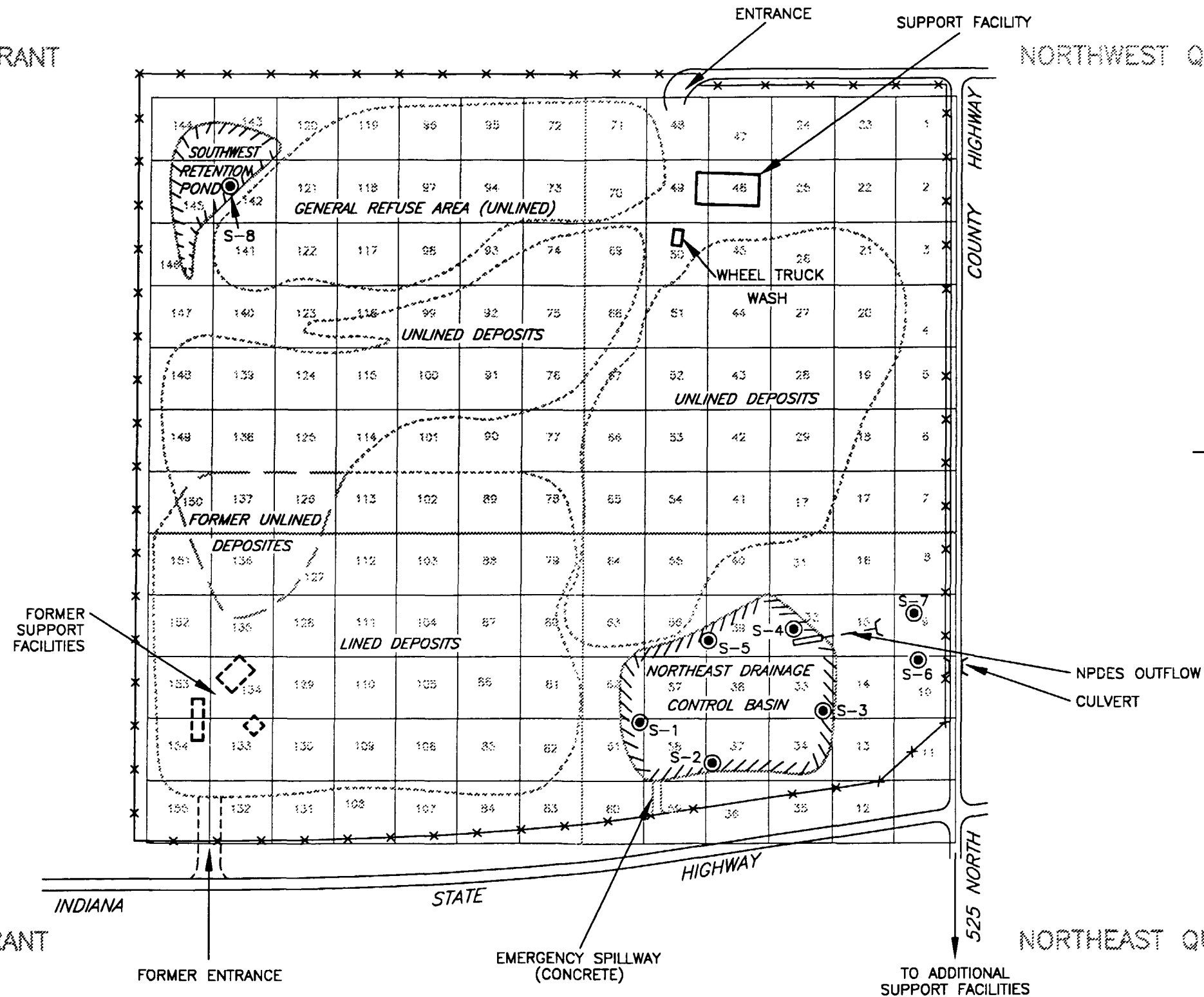
Prior to the collection of any sediment samples in the Northeast Drainage Control Basin, the Southwest Retention Pond or identified sampling locations where standing water is present, surface water samples will be collected.

Grab samples of surface water will be collected as follows:

- i) A new pair of disposable latex or nitrile gloves will be donned at each location.
- ii) Prior to use, sampling equipment will be decontaminated in accordance with Section H.1.4.1.
- iii) Where possible, surface water samples will be collected directly into laboratory-supplied containers by gently lowering the container into the water body and allowing the container to fill. The utmost care will be utilized to minimize agitation of bottom sediments during sample collection. Samples will be collected in order of decreasing volatility.
- iv) In the event grab samples cannot be collected directly into the laboratory containers, grab samples will be collected using a precleaned glass or teflon-coated dipper.

SOUTHWEST QUADRANT

NORTHWEST QUADRANT



SOURCE:
MODIFICATION OF A SITE MAP (4/15/91)
OBTAINED FROM
GEOSCIENCES RESEARCH
ASSOCIATES, INC.

LEGEND

- S-1● PROPOSED SURFACE WATER/
SEDIMENT SAMPLING LOCATIONS
- 155 BLOCK NUMBERS OF GRID
- x—x— FENCE LINE

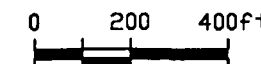
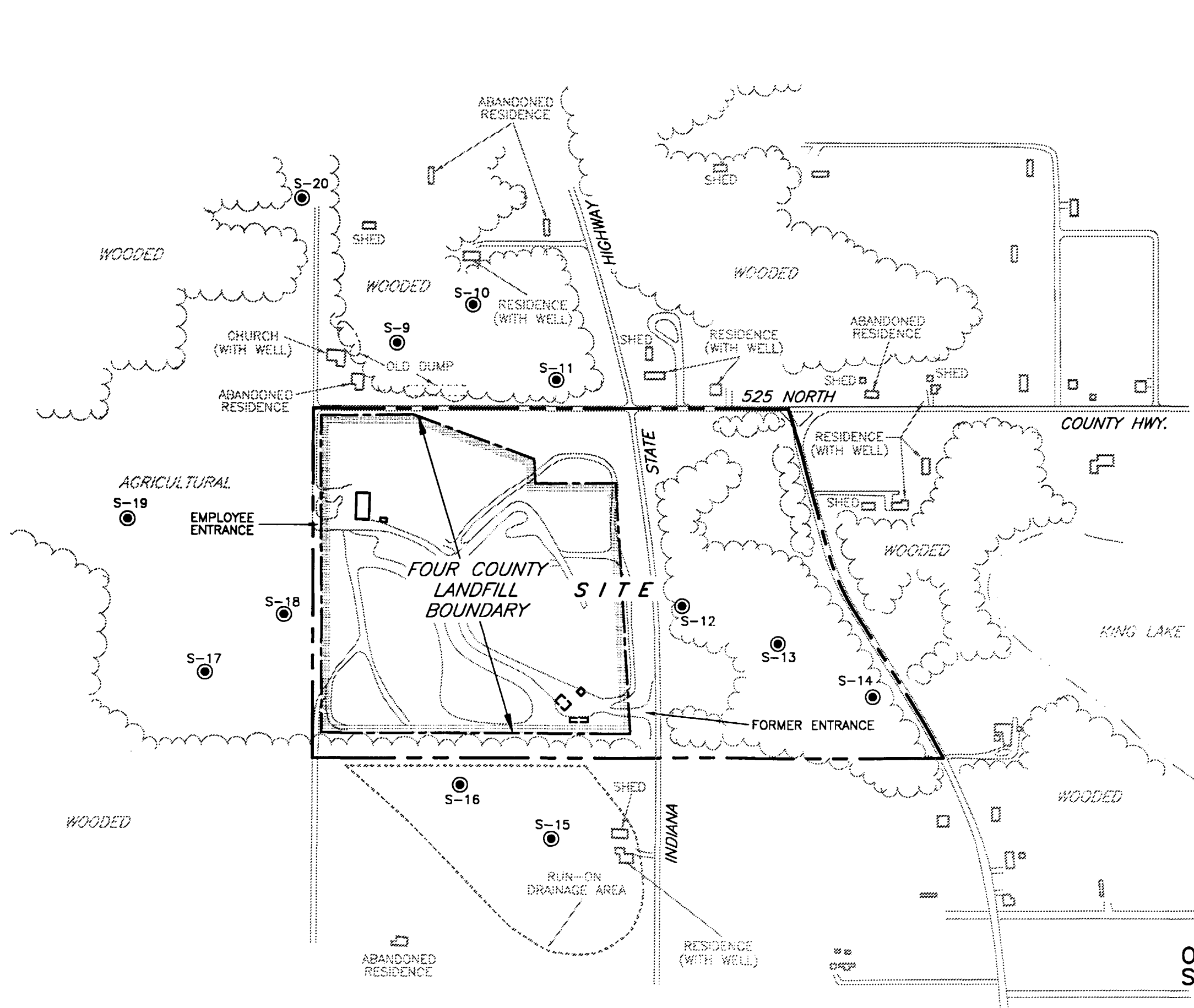
NOTES

LOCATION OF OUTLINES (dashed, wavy)
ARE APPROXIMATE.
SITE GRID = 100 FEET.

SOUTHEAST QUADRANT

NORTHEAST QUADRANT

figure H.1.3
ON-SITE SURFACE WATER
AND SEDIMENT SAMPLING LOCATIONS
FOUR COUNTY LANDFILL SITE
Fulton County, Indiana



SOURCE:
MODIFICATION OF THE
RCRA PART B PERMIT
APPLICATION (6/30/87)
PLAN SHEET NO. 1

LEGEND

- S-9 ● PROPOSED SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS
- PROPERTY LINE

figure H.1.4
OFF-SITE SURFACE WATER AND
SEDIMENT SAMPLING LOCATIONS
FOUR COUNTY LANDFILL
Fulton County, Indiana

- v) The sample will be labelled and then placed into a laboratory-supplied container.
- vi) Collected samples will be placed immediately into a cooler containing ice pending shipment to the project laboratory. All sampling equipment will be cleaned prior to use at another sampling location.

Samples and duplicate surface water samples collected for VOC analysis will be collected directly into laboratory-supplied containers concurrently, whenever possible, to minimize volatilization. Duplicate surface water samples for other analytes will be collected in a glass or teflon lined dipper and then distributed evenly between the laboratory-supplied containers for the sample and duplicate sample. The sample and duplicate sample will be assigned unique sample identification numbers.

Sediment samples will be collected from wetland areas, drainageways and surface water bodies. Sediment sampling locations are approximate only and will be strategically located to avoid obstacles. Care will be taken to minimize the disturbance of sediments while in transit to the sampling location.

Sediment samples will be collected to a depth of 12 inches using the following protocols:

In areas where standing water is absent:

- i) Samplers will don a new pair of disposable latex or nitrile gloves and appropriate PPE.
- ii) Prior to use, sampling equipment will be precleaned in accordance with Section H.1.4.1.
- iii) The top layer of vegetative matter, if present, will be scraped clear using a stainless-steel trowel. This procedure will be

conducted in a manner which minimizes disturbance to the topsoil or sediment beneath.

- iv) A 12-inch deep excavation will be made using the stainless-steel trowel or stainless-steel bucket-type hand auger.
- v) A visual inspection will be conducted of the excavation and a description of the sediment will be recorded.
- vi) Sediment samples will be collected from an interval which is representative of relatively recent deposition on the basis of the visual inspection. It is assumed that the depth interval to be sampled will not exceed 6 inches.
- vii) A new excavation will be made adjacent to the original excavation for the purpose of sample collection. Samples will be collected in order of decreasing analyte volatility.
- viii) Samples for VOC analysis will be collected by excavating soil representative of the entire interval to be sampled. Samples collected for VOC analysis will not be homogenized but will be placed immediately into laboratory-supplied containers in a manner which minimizes headspace within the container.
- ix) Samples for the remaining analytes will be collected by placing a representative aliquot of sediment into a precleaned stainless steel bowl and the sample will be homogenized. The homogenized sample will then be distributed among laboratory-supplied sample containers.
- x) Collected samples will be labelled and placed into a cooler containing ice. All sampling equipment will be cleaned prior to use at another sampling location.

In areas where standing water is present:

- i) The sampler will don a new pair of disposable latex or nitrile gloves. Surface water samples will be collected prior to collection of sediment samples at these locations.
- ii) All sampling equipment will be precleaned as described in Section H.1.3.1.
- iii) The sampler will slowly wade out to the sampling location and press a 3-inch diameter or larger stainless-steel tube or stainless-steel sediment corer into the sediments until resistance is encountered or to a maximum depth of 12 inches.
- iv) The stainless-steel tube or sediment corer will be carefully removed from the sediments by gently turning or rocking the tube to loosen the sediment. The sampler will then gently remove the tube or corer from the sediment.
- v) Water will be allowed to slowly drain from the tube and the sediment collected will be placed in a stainless-steel bowl.
- vi) For VOC analysis, representative portion of the collected sediment will be immediately placed into a laboratory-supplied container in a manner which minimizes headspace in the container.
- vii) The remaining material will be homogenized in the stainless steel bowl and distributed among the remaining containers in order of decreasing analyte volatility. If additional sample is required, steps iii) through v) will be repeated prior to homogenizing the sample until a sufficient volume of sediment has been collected to fill the containers.
- viii) Sample containers will be labelled and placed into a cooler containing ice. Sampling equipment will be cleaned prior to use at another sample location.

Duplicate sediment samples will be collected using the procedures described above except that sufficient volume will be collected for the sample and the duplicate sample. Collected sediment will be placed into a precleaned stainless-steel bowl and homogenized prior to being distributed among the laboratory-supplied containers except that duplicate samples for VOC analysis will be collected immediately and will not be homogenized prior to collection. The sample and duplicate sample will then be placed in laboratory-supplied containers in order of decreasing analyte volatility and each will be assigned a unique sample identification number.

H.1.5.2 GROUNDWATER MONITORING WELL SAMPLING PROTOCOLS

One round of groundwater samples will be collected from the 71 monitoring wells and piezometers presented on Table H.1.5. Each groundwater sample will be submitted to the laboratory and analyzed for TCL VOC, TCL SVOC, total and dissolved TAL metals, TAL total cyanide and landfill indicator parameters.

Groundwater samples will be collected in accordance with the protocols specified below:

- i) The depth to water in each well will be measured to the nearest 0.01 foot using an electronic tape. The measuring device will be decontaminated prior to use following the cleaning sequence provided in Section H.1.4.1.
- ii) When the well cap is removed, the concentration of vapors in the breathing zone will be monitored using a photoionization detector, a combustible gas indicator, a combination gas meter (CO₂, CO, O₂ and H₂S) and a hydrogen cyanide gas meter as described in the HSP in Appendix I. Monitoring will continue at regular intervals throughout the purging and sampling process.
- iii) Prior to sampling, each well will be purged using a precleaned Grundfos Model MP-1 submersible stainless-steel pump

TABLE H.1.5
GROUNDWATER MONITORING WELL NETWORK¹
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

<i>Northwest Quadrant</i>		<i>Northeast Quadrant</i>	
Monitoring Wells = 6		Monitoring Wells = 4	
Piezometers = 18		Piezometers = 13	
MW-26	P-33A	MW-20	P-23C2
MW-30B	P-30A	MW-23B	P-28A
MW-31B	P-30C1	MW-28B	P-28C1
MW-32B	P-30C2	MW-29B	P-28C2
MW-33B	P-32A	P-7B	
MW-34*B ²	P-32C2	P-29A	
P-10	P-31A	P-29C2	
P-11A	P-31C1	P-8A	
P-12A	P-31C2	P-8B	
P-13A	P-34*A	P-8C1	
P-14A	P-34*C1	P-8C2	
P-26A	P-34*C2	P-23A	
		P-23C1	
 <i>Southwest Quadrant</i>		 <i>Southeast Quadrant</i>	
Monitoring Wells = 1		Monitoring Wells = 5	
Piezometers = 14		Piezometers = 12	
MW-24B	P-5C1	MW-21L	P-4A
P-1A	P-5C2	MW-21S	P-4B
P-1	P-24A	MW-21M	P-4C1
P-3	P-24C1	MW-25B	P-4C2
P-6A	P-24C2	MW-27B	P-27A
P-2A		P-3A	P-27C1
P-2B		P-21A	P-27C2
P-2C2		P-25A	
P-5A		P-25C2	
P-5B		P-4A	
		TOTALS:	
		Piezometers	56
		Monitoring Wells	14
			<hr/> 71

¹ All wells known to have been installed are listed, although some may have been damaged or abandoned.
² A piezometer/monitoring well cluster with a numeric designation of "34*" was installed by Geosciences Research Associates between December 1988 and January 1989. The asterisk (*) is not a footnote, but rather a means of distinguishing this cluster from P-34A, also located in the northwest quadrant.

equipped with precleaned reinforced PVC hose. Alternatively, a precleaned stainless steel bailer may be used to purge wells with a limited volume of water present, recover slowly or are easily purged dry. Purging and sampling equipment will be precleaned in accordance with the protocols in Section H.1.4.1. The monitoring wells will be purged by removing a minimum of three standing well volumes of groundwater. The volume of standing water is calculated as follows:

$$V = 0.041 \ d^2 \ h$$

where:

V = volume of standing water in gallons

d = diameter of the well in inches

h = depth of water in feet

Field measurements of pH, conductivity and temperature of the purged water will be obtained and recorded in the field book following removal of each standing well volume and prior to sample collection. Field instruments will be calibrated as specified in the QAPP (Appendix H.2) prior to use. Well purging will continue until three consecutive and consistent readings (± 0.2 units for pH, \pm five percent for conductivity and \pm two degrees for temperature) are obtained or a maximum of five standing well volumes have been removed. Field measuring equipment will be operated in accordance with manufacturer's specifications. In the event that a well is bailed dry prior to achieving three well volumes, groundwater will be permitted to recover to a level sufficient for sample collection. The time that the well was bailed dry will be recorded and the well will be monitored for recovery. Upon recovery, the sample will be collected.

- iv) After purging the required volume of well water, water samples will be collected. Use of the Grundfos MP-1 submersible pump will be the preferred method of sample collection. If the

Grundfos pump is used for sampling, the flow rate will be adjusted to a maximum of 0.1 liters/minute for collection of VOC samples. In the event that there is initially a low volume of water present in the well casing, the water level recovers slowly during purging or the well is easily bailed dry, a stainless steel bailer may be used for sample collection. The bailer will be emptied directly into the appropriate sample containers. Containers will be filled in order of decreasing parameter volatility, using techniques which will minimize sample agitation. VOC samples will be collected in a zero headspace VOA vial. Samples collected for dissolved TAL metal analysis will be filtered through a disposable 0.45 micron filter in the field prior to preservation and analysis. Sample appearance will be recorded in the field book. The groundwater samples may be collected from the bailer used to purge the monitoring well as described above. New nylon rope will be used at each monitoring well.

- v) A field duplicate sample will be collected at a frequency of one per ten investigative groundwater samples collected or at a minimum of one per sampling event. Sample containers will be filled in order of decreasing parameter volatility. Field duplicates will be assigned a unique sample identification number.
- vi) Samples will be collected for matrix spike analysis at a frequency of one per each set of 20 samples collected for chemical analysis. The sample for matrix spike analysis will be collected from a well representative of the condition of the majority of the monitoring wells, turbid or non turbid. Samples will be collected from a representative monitoring well using the same protocol as for the field duplicate with increased sample volume being collected. The chain-of-custody records sent to the project laboratory will indicate the samples collected for matrix spike analysis.

- vii) A field equipment rinsate blank sample will be collected at a frequency of one per ten investigative samples collected or at a minimum of one per sampling event. This sample will consist of distilled/deionized water poured into, and then sampled out of, a precleaned bailer. This will provide a quality assurance check on the decontamination procedures employed for the bailers and sample containers. The rinsate blanks will be assigned a unique sample identification number.
- viii) A trip blank will be provided by the laboratory for each sample cooler shipped containing aqueous VOC samples. Trip blanks will be analyzed for TCL VOCs to provide a check for possible sample contamination during shipping.

Purge waters generated during sampling of Site monitoring wells and piezometers will be temporarily stored in 55-gallon drums or polyethylene tanks. Purge water will be consolidated with leachate in holding tanks currently present at the Site for disposal.

H.1.5.3 Air and Landfill Gas Screening

Air and landfill gas screening will be undertaken in order to provide data suitable for use during the baseline risk assessment and to determine whether landfill-related gases of concern are present at the Site. Landfill gases of concern identified for the Site include methane, VOCs, hydrogen cyanide and hydrogen sulfide. Specific protocol for conducting screening activities for these compounds as well as collection of supporting data are presented in the subsections which follow.

Every effort will be made to collect air samples and data during periods relatively stable wind direction and speed and during periods which would not inhibit the transmission of landfill gases to the surface (i.e. frozen or high moisture ground conditions). This will necessitate the collection of samples during relatively warm and dry periods.

H.1.5.3.1

Meteorological Data

Monitoring of wind speed and direction, temperature, relative humidity, and barometric pressure will be conducted at hourly intervals during the air sampling events. These data will be collected using portable direct reading instruments including a barometer, thermometer, hygrometer or sling psychrometer, and anemometer. Additionally, hourly observations of general meteorological conditions (i.e. overcast conditions, occurrence of precipitation, occurrence of fog, haze or dust, etc.) will be recorded. All observations and data will be recorded in the field log. In the event a significant change in the general meteorological conditions, speed and direction of the wind or temperature is noted between recording events, these new observations will be immediately recorded in the field log.

H.1.5.3.2

Site Inspection

In order to identify areas of the landfill where significant landfill gas emissions may be occurring, a detailed inspection of the landfill will be conducted. The Site inspection will be conducted on a 100 foot by 100 foot grid pattern which will be established prior to conducting the inspection. During the Site inspection, a portable combustible gas indicator and a photoionization detector (PID) will be used in order to screen for the presence of combustible gases. Additionally, detailed observations will be made in order to determine likely areas where landfill gas may be discharging to the surface. Such areas may be identified by gas-stressed vegetation, the presence of deep cracks or fissures in the soil cover, gas bubbles in ponded areas and odors which may be present. In these areas, the combustible gas indicator and a PID will be used in attempting to pinpoint the area where landfill gas discharge is occurring. If any landfill gas discharge areas are noted during the inspection, these locations will be clearly marked in the field with stakes or pin flags.

H.1.5.3.3 VOC Monitoring

Screening for VOC emissions from the Site will be conducted through the collection of ambient air samples on two separate sampling events spaced at least one week apart. Ambient air samples will be collected using precleaned, pre-evacuated, stainless steel passivated Summa® canisters equipped with pneumatic flow regulators and vacuum/pressure gauges. The canister will have a capacity of six liters. Precleaned and pre-evacuated stainless steel Summa® canisters will be obtained from the project laboratory complete with stainless steel vacuum pressure gauges and pneumatic flow controllers capable of maintaining a constant flow rate during the 12-hour duration sampling events. Samples will be collected using the following protocols:

- i) Prior to initiation of the sampling event, the meteorological data discussed in Section H.1.5.3.1 will be recorded. Perimeter sampling locations will be configured such that one sampling point is located in the upwind direction and three sampling points are located in the downwind direction from the landfill. Six on-Site sampling locations will be selected on the basis of the detailed inspection described in Section H.1.5.3.2.
- ii) The Summa® canisters will be inspected and then placed in position for sample collection. The perimeter canisters will be positioned such that air samples will be collected approximately four feet above the ground surface. The six on-Site sampling locations will be placed in close proximity to, and downwind of, the locations selected during the detailed inspection described in Section H.1.5.3.2. In the event that no gas discharge areas are identified during the detailed inspection, canisters will be placed randomly such that three are located in lined portions of the landfill and three are located in unlined portions of the landfill. The valve to the canisters will then be opened to initiate sample collection. The time and vacuum reading when each canister is opened will be recorded in the field log.

- iii) The canisters will be monitored periodically during sample collection activities to ensure the canister is filling properly with ambient air. Meteorological data will be collected during sampling activities as outlined in Section H.1.5.3.1. Any unusual operating conditions or observations will be recorded in the field log.
- iv) QA/QC samples to be collected in association with VOC screening activities include field duplicate samples. Field duplicate samples will be collected at a rate of one per ten investigative samples. Field duplicates will be collected by concurrently filling two separate containers in close proximity to one another.
- v) After 12 hours, sampling will be terminated by closing the valve on the Summa® canisters. The time that each container was closed will be recorded in the field log. Canisters will be properly labeled and packed for shipment to the project laboratory under chain-of-custody protocol.

H.1.5.3.3 Hydrogen Cyanide and Hydrogen Sulfide Screening

Screening for hydrogen cyanide and hydrogen sulfide will be conducted using portable direct reading instruments with a sensitivity of one part per million. Screening for hydrogen cyanide and hydrogen sulfide will be conducted concurrently with collection of VOC screening samples. Screening using the direct reading instruments will be conducted as outlined below:

- i) Prior to conducting the screening operations, direct reading instruments will be calibrated in accordance with manufacturer's specifications.
- ii) Meteorological conditions will be documented as outlined in Section H.1.5.3.1.

- iii) Readings for hydrogen cyanide and hydrogen sulfide will be collected from the perimeter of the landfill and the six sampling locations identified for VOC sample collection discussed in Section H.1.5.3.3. Data will be recorded on an hourly basis during the two 12-hour duration air screening events. Field personnel will walk the perimeter of the landfill and record instrument readings at 100-foot intervals. In the event a detection of one or more of the constituents is noted between nodes, the location and the instrument reading will be carefully documented in the field log.

H.1.5.3.4 Soil Gas Survey

A soil gas survey will be conducted around the perimeter of the landfill in order to assess the potential for methane gas migration through the subsurface beyond the perimeter of the landfill. The soil gas survey will be conducted at 100-foot intervals around the perimeter of the landfill using the procedure described below:

- i) Prior to conducting the soil gas survey, sample locations will be staked out at 100-foot intervals near the Site fence. Areas where vegetation may be stressed by landfill gases, if present, will also be targeted for sampling. The natural gas indicator will be properly calibrated according to the manufacturer's specifications.
- ii) At each of the identified sample locations, a plunger bar will be used to advance a hole to a depth of approximately three feet below ground surface. The plunger bar is then removed from the borehole.
- iii) The probe of the Gastech, Inc. Model NP-204 Portable Natural Gas Indicator will be immediately inserted into the borehole and

the space around the probe sealed in order to minimize ambient air infiltration into the borehole.

- iv) The gas indicator will be set on high range and the aspirator bulb will be slowly squeezed and released several times to induce air flow through the meter. The highest continuous reading will then be recorded in the field log.
- v) In the event that a concentration of gas of less than 5 percent on the high scale is recorded, the procedure will be repeated using the low range on the meter.

H.1.6.0 ANALYTICAL PROTOCOLS

Sediment and surface water samples will be analyzed for organic analytes on the target compound list and inorganic analytes on the target analyte list. Groundwater samples will be analyzed for TCL VOC, TCL SVOC, TAL total and dissolved metals, TAL total cyanide and landfill leachate indicator parameters. Selected groundwater samples within an identified groundwater plume will be analyzed for all Appendix IX parameters, BOD and COD. Landfill gas samples will be analyzed for VOC. A summary of the sampling and analytical program is provided on Table H.1.6.

All chemical analyses will be conducted in accordance with USEPA approved laboratory methods as discussed in the QAPP. Analytical data will be validated through a data quality assessment and validation. Data validation will be completed as discussed in the QAPP (Appendix H.2).

TABLE H.1.6

SUMMARY OF SAMPLING AND ANALYSIS PROGRAM ¹
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

<i>Sample Matrix</i>	<i>Field Parameters</i>	<i>Laboratory Parameters ²</i>	<i>Investigative Samples</i>	<i>Field Blanks</i>	<i>Field Duplicates</i>	<i>Matrix Spike MS/MSD ³</i>	<i>Total</i>
Groundwater (first round)	pH specific conductivity temperature water level	TCL VOC, TCL SVOC, TAL total and dissolved metals, TAL cyanide, pH, sulfate, chloride, nitrate, ammonia, TDS, TSS, alkalinity	71	8	8	4	95
Groundwater (second round)	pH specific conductivity temperature water level	Full Appendix IX BOD, COD	TBD ⁴	1/10 ⁵	1/10	1/20 ⁶	TBD
Sediment		TCL VOC, TCL SVOC TCL Pesticides/PCB, TAL Metals, TAL Cyanide TOC	20	2	2	1	26
Surface Water	pH specific conductivity temperature water level	TCL VOC, TCL SVOC TCL Pesticides/PCB, TAL Metals, TAL Cyanide	20	2	2	1	26
Air	H ₂ S, HCN Methane	VOC	20	0	2	0	22

¹ One trip blank, which consists of two analyte-free water filled 40-mL preserved glass vials for TCL VOC water samples, will be shipped with each cooler of TCL VOC water samples.

² TCL = Target Compound List
TAL = Target Analyte List
VOC = Volatile Organic Compounds
SVOC = Semivolatile Organic Compounds
PCB = Polychlorinated Biphenyls
TDS = Total Dissolved Solids
TSS = Total Suspended Solids
BOD = Biological Oxygen Demand
COD = Chemical Oxygen Demand
TOC = Total Organic Carbon

³ Matrix spike/matrix spike duplicate (MS/MSD) samples are required for organic analyses. Samples designated for MS/MSD analyses will be collected with extra volumes for aqueous samples, at a frequency of one per group of twenty (20) or fewer investigative samples. Triple the normal sample volumes will be collected for aqueous VOC samples and double the normal sample volumes will be collected for extractable organic samples. Inorganic analyses require one matrix spike/laboratory duplicate (MS/DUP) to be analyzed at a frequency of one per group of twenty (20) or fewer investigative samples.

⁴ To be determined based on results of the first round groundwater sampling.

⁵ One per 10 or fewer investigative samples.

⁶ One per 20 or fewer investigative samples.

APPENDIX H.2

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN (QAPP)

LIST OF ACRONYMS AND SHORT FORMS

BOD	-	Biological Oxygen Demand
COD	-	Chemical Oxygen Demand
°C	-	Degree Centigrade
CRA	-	Conestoga-Rovers & Associates
DQO	-	Data Quality Objective
FSAP	-	Field Sampling and Analysis Plan
HLI	-	Heritage Laboratories, Inc.
IDEM	-	Indiana Department of Environmental Management
MDL	-	Method Detection Limit
MS/DUP	-	Matrix Spike/Laboratory Duplicate
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
PCB	-	Polychlorinated Biphenyls
PE	-	Performance Evaluation
PM	-	Project Manager
PRPs	-	Potentially Responsible Parties
QA	-	Quality Assurance
QA/QC	-	Quality Assurance/Quality Control
QAO	-	Quality Assurance Officer
QAPP	-	Quality Assurance Project Plan
QC	-	Quality Control
RI/FS	-	Remedial Investigation Feasibility Study
RPD	-	Relative Percent Difference
%RSD	-	Percent Relative Standard Deviation
Site	-	Four County Landfill Site; Fulton County, Indiana
SOP	-	Standard Operating Procedures
SVOC	-	Semivolatile Organic Compounds
SW-846	-	"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA SW-846
TAL	-	Target Analyte List
TCL	-	Target Compound List
TDS	-	Total Dissolved Solids
TOC	-	Total Organic Carbon
TO-14	-	"Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air" EPA-600/4-79-041, April 1984
TSS	-	Total Suspended Solids
USEPA	-	United States Environmental Protection Agency
VOC	-	Volatile Organic Compounds

QUALITY ASSURANCE PROJECT PLAN (QAPP)

PROJECT TITLE: Four County Landfill Site RI/FS QAPP

PREPARED BY: CONESTOGA-ROVERS & ASSOCIATES (CRA)

Approved By: _____ Date: _____
Project Manager - CRA
Bruce Clegg

Approved by: _____ Date: _____
Project Coordinator - CRA
Steven Wanner

Approved By: _____ Date: _____
Quality Assurance/
Quality Control Officer - Analytical Activities - CRA
Deborah Gage

Approved By: _____ Date: _____
QA/QC Officer - Field Activities - CRA
Joseph Campisi

Approved By: _____ Date: _____
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QUALITY ASSURANCE PROJECT PLAN (QAPP)

PROJECT TITLE: Four County Landfill Site RI/FS QAPP

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FIELD AND LABORATORY INSTRUMENTATION

H.2.1.0 INTRODUCTION

The United States Environmental Protection Agency (USEPA) and the Indiana Department of Environmental Management (IDEM) require that all environmental monitoring and measurements efforts mandated or supported by USEPA and IDEM participate in a centrally managed quality assurance (QA) program.

Any party generating data under this program has the responsibility to implement minimum procedures to assure that the precision, accuracy, completeness and representativeness of its data are known and documented. To ensure the responsibility is met uniformly, each party must prepare a written Quality Assurance Project Plan (QAPP) covering each project it is to perform.

This QAPP presents the organization, objectives, functional activities and specific quality assurance and quality control (QC) activities associated with the Remedial Investigation/Feasibility Study (RI/FS) to be conducted at the Four County Landfill Site in Fulton County, Indiana (Site). This QAPP also describes the specific protocols which will be followed for sampling, sample handling and storage, chain of custody, laboratory and field analysis.

All QA/QC procedures will be in accordance with applicable professional technical standards, USEPA and IDEM requirements, government regulations and guidelines, and specific project goals and requirements. This QAPP has been prepared by Conestoga-Rovers & Associates (CRA) in accordance with all USEPA QAPP guidance documents, in particular, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (QAMS-005/80) and the Region V Model QAPP (1991) and is in accordance with the QAPP requirements as specified in the Agreed Order for Remedial Investigation/Feasibility Study, Cause No. OER-92.

H.2.2.0 PROJECT DESCRIPTION

The background and history of the Site is presented in Section 2.2 of the RI/FS Work Plan.

H.2.2.1 SAMPLING NETWORK AND RATIONALE

The sampling network and rationale are presented in Section 7.0 of the RI/FS Work Plan. Specific sampling procedures are detailed in the Field Sampling and Analysis Plan (FSAP) (Section H.1 of Appendix H to the RI/FS Work Plan).

H.2.2.2 PROJECT OBJECTIVES AND SCOPE

The purpose of the RI/FS is to gather sufficient information to complete an evaluation of the nature and extent of contamination at the Site and to identify areas which pose a threat to public health, welfare or the environment.

H.2.2.3 PARAMETERS TO BE TESTED AND FREQUENCY

Sample matrices, analytical parameters and frequencies of sample collection are presented in Table H.2.1. The rationale for the selection of parameters is discussed in Section 7.0 of the RI/FS Work Plan.

H.2.2.4 DATA QUALITY OBJECTIVES (DQOs)

Data quality objectives (DQOs) are qualitative and quantitative statements which specify the quality of the data required to support decisions made during investigation activities and are based on the end uses of the data to be collected. As such, different data uses may require

different levels of data quality. There are five levels of analytical support which address various data uses, the QA/QC effort and analytical methods required to achieve the desired level of quality.

DQOs have been established in accordance with the USEPA guidance document entitled "Data Quality Objectives for Remedial Response Activities - Development Process", dated March 1987, in conjunction with the document, "Data Quality Objectives for Remedial Response Activities - Example Scenario RI/FS Activities at a Facility with Contaminated Soils and Groundwater", dated March 1987. Reference to these documents ensures that the data base developed during the RI/FS activities meets the objective and quality necessary for its intended use.

DQOs can be classified for the measurement data by defining the level of analytical support assigned to each type of data measurement.

The following defines the different levels of DQO analytical support:

- i) Level I - Field screening or analysis using portable instruments such as a pH meter, photoionization detector, conductivity and temperature meters and a landfill gas meter (O₂, HCN, H₂S, CO);
- ii) Level II - Field analyses using more sophisticated portable analytical instruments;
- iii) Level III - All analyses performed in off-Site analytical laboratories using EPA procedures other than the Contract Laboratory Program (CLP) Routine Analytical Services (RAS);
- iv) Level IV - CLP-RAS performed in a CLP analytical laboratory using CLP procedures; and
- v) Level V - Non-standard analytical methods performed in an off-Site laboratory.

Table H.2.2 presents the level of DQO analytical support for each group of parameters.

H.2.2.5 PROJECT SCHEDULE

The project schedule is presented in Section 13.2 of the RI/FS Work Plan.

H.2.3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Conestoga-Rovers and Associates (CRA), as consultant to the Four County Landfill PRP Group, has overall responsibility for all phases of the RI/FS at the Site. CRA will perform all sampling, well purging and field analyses.

Heritage Laboratories, Inc. (HLI) as project laboratory will perform the analyses of all sediment, surface water and groundwater samples collected during the RI/FS. Enseco-Air Toxics will perform the analyses of all air samples collected during the RI/FS.

All firms will provide project management as appropriate to their responsibilities. CRA will provide administrative oversight and QA/QC for all deliverables. CRA will maintain a file copy of all laboratory deliverables. All final project deliverables will be issued by CRA.

Figure H.2.1 presents the key staff organization for the project and the associated management structure. A summary of the responsibilities of key project personnel is presented below:

Richard G. Shepherd - Principal-in-Charge - CRA

- provide overall corporate management
- participation in key technical negotiations with IDEM and Four County Landfill Technical Committee
- managerial and technical guidance to CRA's project managers

Bruce Clegg - Project Manager - CRA

- overview of field activities
- overview of laboratory activities
- managerial guidance to technical group

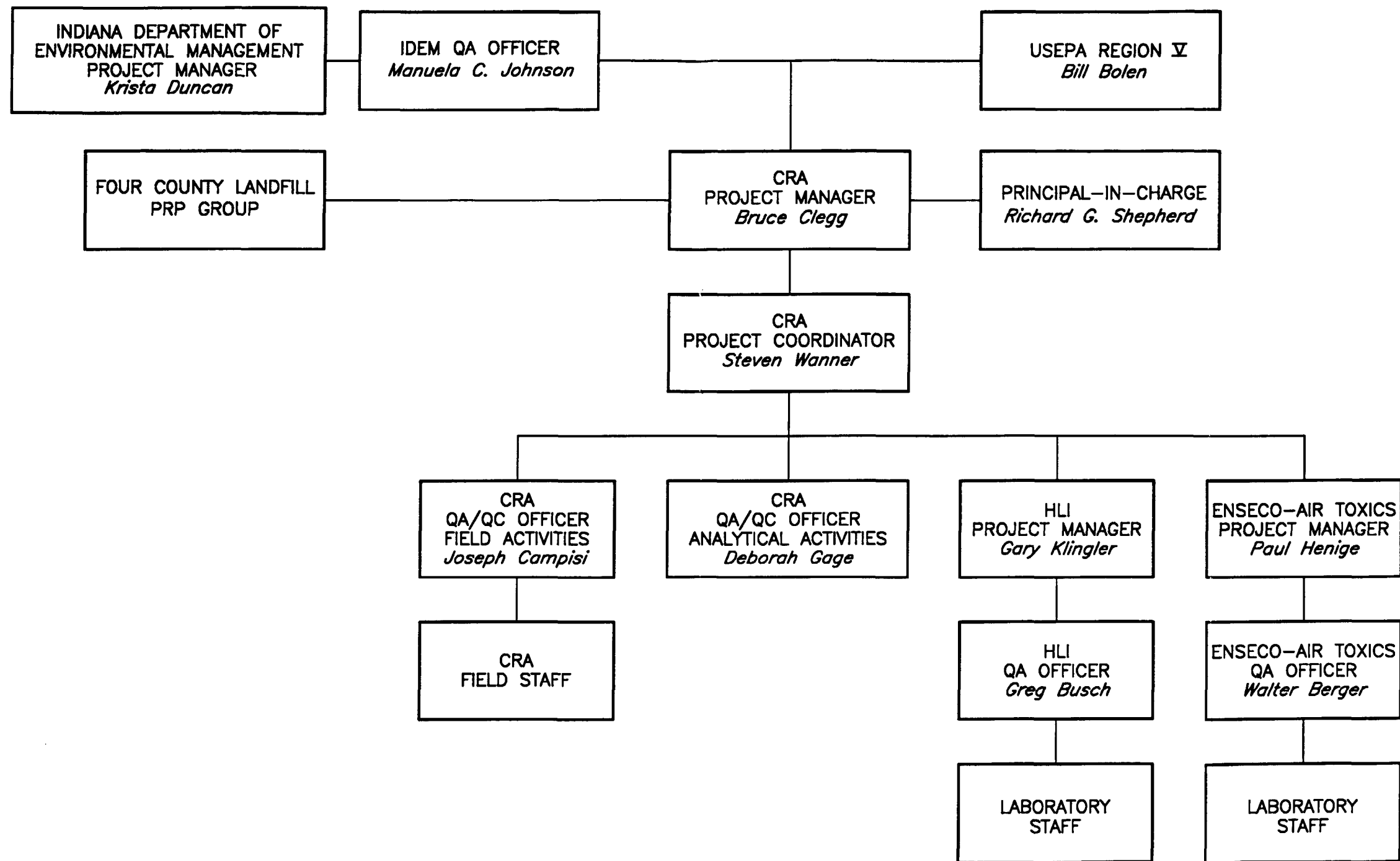


figure H.2.1
PROJECT ORGANIZATION
FOUR COUNTY LANDFILL SITE
Fulton County, Indiana

Steven Wanner - Project Coordinator - CRA

- data assessment
- preparation and review of reports
- evidence file custodian
- technical representation of project activities

Deborah Gage - QA/QC Officer - Analytical Activities - CRA

- perform laboratory system audits
- overview and review field QA/QC
- coordinate supply of performance evaluation samples
- review laboratory QA/QC
- data validation and assessment
- advise on data corrective action procedures
- preparation and review of reports
- QA/QC representation of project activities

Joseph Campisi - QA/QC Officer - Field Activities - CRA

- management of field activities and field QA/QC
- data assessment
- technical representation of field activities
- preparation of Standard Operating Procedures (SOPs) for field activities
- preparation of reports
- advise on field corrective action procedures

Paul Henige - Project Manager - Enseco-Air Toxics

Gary Klingler - Project Manager - HLI

- ensures all resources of the laboratory are available on an as-required basis
- coordinate laboratory analyses
- supervise in-house chain-of-custody
- schedule sample analyses
- oversee data review
- oversee preparation of analytical reports
- overview of final analytical reports

Walter Berger - Laboratory QA Officer - Enseco-Air Toxics

Greg Busch - Laboratory QA Officer - HLI

- overview laboratory quality assurance
- overview QA/QC documentation
- conduct detailed data review
- decide laboratory corrective actions, if required
- technical representation of laboratory QA procedures
- preparation of laboratory SOPs
- approve final analytical reports prior to submission to CRA

Jan Dalman - Sample Custodian - Enseco-Air Toxics

Debbie Edwards - Sample Custodian - HLI

- receive and inspect the incoming sample containers
- record the condition of the incoming sample containers
- sign appropriate documents
- verify chain of custody and its correctness
- notify laboratory manager and laboratory supervisor of sample receipt and inspection
- assign a unique identification number and customer number, and enter each into the sample receiving log
- with the help of the operations manager, initiate transfer of the samples to appropriate lab sections
- control and monitor access/storage of samples and extracts

IDEM RESPONSIBILITIES

The IDEM Project Manager (PM) will be responsible for overview of this project. The PM will also be responsible for providing approval of the QAPP. Ms. Krista Duncan is the PM for the RI/FS activities. The IDEM QA Officer for the RI/FS activities is Mr. Manuela C. Johnson. The IDEM QA Officer is responsible for the final review and approval of the QAPP for IDEM.

USEPA RESPONSIBILITIES

USEPA Region V will provide technical support and review to IDEM.

H.2.4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analyses and reporting that will provide results which are legally defensible in a court of law. Specific procedures for sampling, chain-of-custody, laboratory instruments calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment and corrective action are described in subsequent sections of this QAPP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness and comparability.

H.2.4.1 LEVEL OF QA EFFORT

Field blank, trip blank, field duplicate and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling program. Field and trip blanks consist of analyte-free water and will be submitted to the laboratory to provide the means to assess the quality of the data resulting from the field sampling program. Field blank samples are analyzed to check for procedural contamination at the Site which may cause sample contamination. Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage. Field duplicate samples are analyzed to check for sampling and analytical reproducibility. Matrix spikes provide information about the effect of the sample matrix on the preparation and measurement methodology. All matrix spikes for organic analyses are performed in duplicate. Matrix spike/matrix spike duplicate (MS/MSD) samples are designated/collected for organic analyses only. A matrix spike/laboratory duplicate (MS/DUP) will be designated for inorganics analysis. For air samples, laboratory control sample/laboratory control sample duplicates (LCS/LCSD) will be analyzed.

The general level of the QA effort will be one field duplicate and one field blank per ten or fewer investigative samples or a minimum of one per sampling event. One trip blank consisting of

analyte-free water will be included along with each shipment of aqueous investigative VOC samples.

MS/MSD samples are designated for and collected with the investigative samples submitted for organic analyses. Aqueous MS/MSD samples must be collected at triple the volume for VOC analyses and double the normal volume for all other aqueous organic analyses. Soil MS/MSD samples do not require extra sample volume. One MS/MSD sample will be collected/designated for every 20 or fewer investigative samples per sample matrix (i.e., groundwater, sediment, surface water). MS/DUP samples are designated for the investigative samples submitted for inorganics analyses. No additional volume is required for MS/DUP analyses. One MS/DUP will be designated for every 20 or fewer investigative samples per sample matrix. One LCS/LCSD sample will be analyzed by the laboratory for every 20 or fewer investigative air samples per batch.

The number of field blank, field duplicate, MS/MSD and MS/DUP samples is summarized in Table H.2.1.

The level of QA effort provided by the laboratories for the samples will be consistent with the level of QA effort specified in the following documents:

- i) "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA SW-846, 3rd edition, November 1986;
- ii) "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983;
- iii) "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air", EPA-600/4-79-041, April 1984; and
- iv) The SOPs provided in Attachment H.2-1 to Appendix H.2 (Attachment H.2-1).

The QA level of effort for the field measurements of pH, specific conductance, methane gas, hydrogen cyanide and hydrogen sulfide will be as described in the SOPs in Attachment H.2-1. Temperature readings will be obtained with the pH measurements. Water level will be measured to the nearest 0.01 ft. using an electric sounding water level meter.

H.2.4.2 ACCURACY, PRECISION AND SENSITIVITY OF ANALYSES

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols.

SOPs for the field equipment to measure pH, conductivity, temperature, methane gas, hydrogen cyanide and hydrogen sulfide are provided in Attachment H.2-1. SOPs for the laboratory analyses are provided in Attachment H.2-1. These include the accuracy and precision required for the analyses. The sensitivity required for the analyses is presented in Tables H.2.3 through H.2.9 of this QAPP.

H.2.4.3 COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. It is expected that the laboratories will provide data meeting the QC acceptance criteria for 80 percent or more of all samples tested using the specified methods. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\text{Completeness} = \frac{\text{Valid (usable) Data Obtained}}{\text{Total Data Planned}} \times 100$$

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition or an environmental condition. Representativeness is a qualitative parameter which is dependent upon the proper design of the sampling program and proper laboratory protocol. The sampling network was designed to provide data representative of Site conditions. During development of this network, consideration was given to the historical plant operations, existing analytical data and physical setting and processes. The rationale of the sampling network is discussed in detail in the RI/FS Work Plan. Representativeness will be satisfied by insuring that the RI/FS Work Plan is followed, proper sampling techniques are used, proper analytical procedures are followed and holding times of the samples are not exceeded in the laboratory.

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the QAPP, are expected to provide comparable data. However, these new analytical data may not be directly comparable to existing data because of differences in procedures and QA objectives.

H.2.4.4 FIELD MEASUREMENTS

Measurement data will be generated in many field activities. These activities include, but are not limited to, the following:

- i) documenting time and weather conditions;
- ii) determining pH, specific conductivity, and temperature of groundwater and surface water samples;
- iii) verifying well development and pre-sampling purge volumes; and

- iv) determining well water levels.

The general QA objective for such measurement data is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the use of standardized procedures.

H.2.5.0 SAMPLING PROCEDURES

Procedures and protocols for collecting samples and for performing all related field activities are presented in the FSAP (Appendix H.1).

H.2.6.0 SAMPLE CUSTODY AND DOCUMENT CONTROL

It is IDEM and Region V Policy to follow the USEPA Region V sample custody, or the chain-of-custody protocols as described in "NEIC Policies and Procedures", EPA-330/9-78-001-R, revised August 1991. This custody is in three parts: sample collection, laboratory analysis and final evidence files. Final evidence files, including all originals of laboratory reports are maintained under document control in a secure area.

A sample or evidence file is in your custody if it:

- i) is in your possession;
- ii) is in your view, after being in your possession;
- iii) is in your possession and you place them in a secured location;
or
- iv) is in a designated secure area.

H.2.6.1 FIELD CHAIN-OF-CUSTODY PROCEDURES

The sample packaging and shipment procedures summarized below will insure that the samples will arrive at the laboratory with the chain-of-custody intact. The protocol for specific sample numbering using case numbers and traffic report numbers, if applicable, and other sample designations are included in the FSAP.

H.2.6.1.1 Field Procedures

- 1) The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched to the laboratory. As few people as possible should handle the samples.

- 2) All bottles will be labeled with unique sample numbers.
- 3) Sample labels are to be completed for each sample using waterproof ink.

H.2.6.1.2 Field Logbooks/Documentation

Field logbooks will be used to record the data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the Site could reconstruct a particular situation without reliance on memory.

The title page of each logbook will contain the following:

- i) person to whom the logbook is assigned;
- ii) logbook number;
- iii) project name;
- iv) project start date; and
- v) end date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the Site and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded in the field logbook. All entries will be made in ink with no erasures. If an incorrect entry is made, the information will be crossed out

with a single strike mark. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the sampling point which includes compass direction and distance taken from a reference point will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Copies of all field book entries will be provided to IDEM as part of the monthly report.

Samples will be collected following the sampling procedures documented in the FSAP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth from which the sample was collected, volume of sample and number of containers. A unique sample identification number will be assigned during sample collection. Field QC samples, which will receive unique sample identification numbers, will be submitted to the laboratory blind to avoid laboratory bias of field QC samples.

Table H.2.10 presents the container, preservation, shipping and packaging requirements for the samples to be collected. Container cleaning procedures will be consistent with "Specification and Guidance for Obtaining Contaminant-Free Sample Containers", OSWER Directive #9240.0-05A, April 1992. The laboratory will use Eagle-Pitcher or equivalent sample containers.

H.2.6.1.3 Transfer of Custody and Shipment Procedures

1. Samples are accompanied by a properly completed chain-of-custody record. The sample numbers and locations will be listed on the chain-of-custody record. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to the laboratory, or to/from a secure storage area.

2. Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory. This procedure includes use of a custody seal attached to the front right and back left of the cooler. The custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.
3. Whenever samples are split with another party, a separate chain-of-custody record is prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the other party should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses to sign, this is noted in the "Received By" space.
4. All shipments will be accompanied by the chain-of-custody record identifying the contents. The original record and yellow copy will accompany the shipment, and the pink and goldenrod copies will be retained by shipper (if different than the sampler) and the sampler for their files.
5. If the samples are sent by commercial carrier, a bill of lading will be used. Receipts of bills of lading will be retained as part of the permanent custody documentation. Commercial carriers are not required to sign off on the custody record provided the custody forms are sealed inside the sample cooler and the custody seals remain intact.

H.2.6.2 LABORATORY CHAIN-OF-CUSTODY PROCEDURES

The sample custodian will assign a unique number to each incoming sample for use in the laboratory. The unique number and

customer number will then be entered into the sample receiving log. The laboratory date of receipt will also be noted.

Laboratory custody procedures and document control for those samples analyzed by the project laboratory will be carried out as specified in the appropriate SOP included in Attachment H.2-1.

H.2.6.3 STORAGE OF SAMPLES

After the sample custodian has prepared the logbook, the chain-of-custody results will be checked to ensure that all samples are stored in the appropriate locations. All samples will be stored within an access controlled location and will be maintained preserved (as specified in Table H.2.9) until completion of all analytical work or, at a minimum, for 30 days after receipt of the final report by CRA.

H.2.6.4 FINAL EVIDENCE FILES CUSTODY PROCEDURES

Evidential files for the entire project will be maintained by CRA and will consist of the following:

- i) project plan;
- ii) project logbooks;
- iii) field data records;
- iv) sample identification documents;
- v) chain-of-custody records;
- vi) correspondence;
- vii) references, literature;

- viii) final data packages;
- ix) miscellaneous - photos, maps, drawings, etc.; and
- x) final report.

The evidentiary file materials will be the responsibility of the evidentiary file custodian with respect to maintenance and document removal.

The laboratories will be responsible for maintaining analytical logbooks and laboratory data. Raw laboratory data files will be inventoried and maintained by the laboratories for a period of six years, at which time CRA will advise the laboratories regarding the need for additional storage.

H.2.7.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes or references the procedures for maintaining the accuracy for the instruments and measuring equipment which will be used for performing field measurements and laboratory analyses. These instruments and equipment will be calibrated or the calibration verified prior to each use or according to a periodic schedule.

H.2.7.1 FIELD INSTRUMENTS/EQUIPMENT

Instruments and equipment used to gather, generate or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specification.

Equipment to be used during the field sampling will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manual for each instrument to ensure that all maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed so that notations on any prior equipment problem are not overlooked, and all necessary repairs to equipment have been carried out.

H.2.7.1.1 Field Instrument Calibration

Calibration of the field instruments will be performed prior to the collection of each water sample if well purging data indicate a change ($>\pm 10$ percent) in pH and/or conductivity from the last location sampled. Calibration of field instruments will be performed daily during groundwater and air sampling and the calibration will be checked after a maximum of 10 samples and the end of sample analysis. The field equipment will be maintained, calibrated and operated in a manner consistent with the manufacturer's guidelines and the SOPs in Attachment H.2-1.

Water levels will be measured to the nearest 0.01 foot using an electronic sounding water level meter. No field calibration is possible.

H.2.7.2 LABORATORY INSTRUMENTS

Calibration of laboratory equipment will be based on approved written procedures. Records of calibration, repairs, or replacement of instruments will be filed and maintained by the designated laboratory personnel performing quality control activities. These records will be filed at the location where the work is performed and will be subject to QA audit. For all instruments, the laboratory will maintain a factory-trained repair staff with in-house spare parts or will maintain service contracts with vendors.

The records of calibration will be kept as follows:

- 1) If possible, each instrument will have record of calibration permanently affixed with an assigned record number.
- 2) A label will be affixed to each instrument showing description, manufacturer, model numbers, date of last calibration and by whom calibrated (signature), due date of next calibration and compensation or correction figures, as appropriate.
- 3) A written calibration procedure will be available for each piece of test and measurement equipment.
- 4) Any instrument that is not calibrated within the manufacturer's original specification will display an appropriate warning tag.

Specific calibration procedures are detailed in the respective methods and the associated SOPs as presented in Attachment H.2-1.

H.2.8.0 ANALYTICAL PROCEDURES

The sediment, air, surface water and groundwater samples collected for chemical analyses will be analyzed using the methods presented in Table H.2.11.

H.2.9.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

This section presents the internal quality control checks and the frequency of the checks which will be employed for field measurements and laboratory analyses.

H.2.9.1 FIELD QC

Quality control procedures for field measurements will be limited to checking the reproducibility of the measurements in the field by obtaining multiple readings and by calibrating the instruments (where appropriate).

Quality control of field sampling will involve collecting field duplicates and field blanks in accordance with the applicable procedures and frequencies described in Sections H.2.4.1 and H.2.5.0, and the level of effort indicated in Table H.2.1.

H.2.9.2 LABORATORY QC

Specific procedures related to internal laboratory QC samples (namely, matrix spikes, surrogate spikes, blanks, blind check samples, laboratory duplicate and matrix spike duplicates) are detailed in the following subsections.

The internal QC checks for the analyses will follow the appropriate methods specified in Table H.2.11 and the laboratory SOPs in Attachment H.2-1.

H.2.9.2.1 Initial and Continuing Calibration Checks

The compliance requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of

producing acceptable quantitative data. The initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of an analysis run, while the continuing calibration checks document that the initial calibration is still valid, and that satisfactory maintenance and adjustment of the instrument on a day-to-day basis is achieved. The specific control criteria and corrective action requirements for these calibrations will be as specified in the respective methods presented in Table H.2.11 and the SOPs presented in Attachment H.2-1.

H.2.9.2.2 Internal Standards Performance

The internal standards performance criteria ensure that GC/MS sensitivity and response is stable during every run. Acceptance criteria will be as specified in the referenced methods.

H.2.9.2.3 Method Blank Samples

A method blank sample will be analyzed by the laboratory at a frequency of one blank per twenty analyses or, in the event that an analytical batch consists of less than twenty samples, one method blank sample will be analyzed. The method blank sample, an aliquot of analyte-free water or sodium sulfate for solid organic analyses, will be carried through the entire analytical procedure.

H.2.9.2.4 MS/MSD, MS/DUP, LCS/LCSD

MS/MSD, MS/DUP and LCS/LCSD sample sets will be analyzed at a minimum frequency of one per twenty investigative samples. Acceptance criteria and compounds that will be used for matrix spikes are identified in the SOPs presented in Attachment H.2-1. Percent spike recoveries will be used to evaluate analytical accuracy while relative percent difference between the duplicate analyses will be used to assess analytical precision.

H.2.9.2.5 Surrogates

Surrogates are used in all GC and GC/MS analyses. Every blank, standard, and investigative sample including MS/MSD samples will be spiked with surrogate compounds prior to purging VOC or extracting SVOC and pesticide/PCB samples.

Surrogates will be spiked into the samples according to the appropriate analytical methods. Surrogate spike recoveries will fall within the control limits set by procedures specified in the method for analytes falling within the quantitation limits without dilution. Dilution of samples to bring the analyte concentration into the linear range of calibration may dilute the surrogates out of the quantitation limit; assessment of analytical quality in these cases will be based on the quality control embodied in the calibration check and MS/MSD samples.

H.2.9.2.6 Blind Check Samples

As supplied by IDEM, an analytical batch may contain a blind check sample. In general, the blind check sample will be obtained from IDEM and supplied to CRA. The analytes employed in this check sample will be a representative subset of the analytes of interest.

The percent recovery of analytes will be calculated from the results of the check samples as defined in Section H.2.13.2.

H.2.9.2.7 Trip Blank Samples

Trip blank samples will be submitted with aqueous investigative VOC samples only, and will be used to determine if cross-contamination has occurred during the shipment and storage of investigative samples. Trip blank samples will be prepared by the laboratory

by filling two preserved 40-mL vials with organic-free deionized water. The trip blank samples will be kept with the investigative samples throughout the duration of the sampling event and, upon return to the laboratory, will be analyzed to determine the presence of VOC introduced during shipment and/or storage.

H.2.10.0 DATA REDUCTION, VALIDATION AND REPORTING

The project laboratories will perform analytical data reduction in-house under the direction of the laboratory QA officer. The laboratory QA officer will be responsible for assessing data quality and advising CRA of any data which were qualified based on laboratory QC criteria. Data reduction, review and reporting by the laboratory will be conducted as detailed in the following. It should be noted, however, that "sign-off" will be required following completion of each step.

1. Raw data produced and reduced by the responsible analyst is turned over for independent review by another analyst.
2. The area supervisor reviews the data for attainment of quality control criteria presented in the referenced analytical methods.
3. Upon completion of all reviews and acceptance of the raw data by the laboratory operations manager, a report will be generated and sent to the laboratory quality assurance officer.
4. The laboratory QA officer will complete a thorough inspection of all reports.
5. The QA officer and area supervisor will decide whether any sample re-analysis is required.
6. Upon acceptance of the preliminary reports by the QA officer, final reports will be generated and signed by the QA officer.

CRA QA/QC Officer - Analytical Activities will conduct an evaluation of data reduction and reporting by the laboratory. These evaluations will consider the finished data sheets, field blank data, field duplicate data and recovery data for surrogate and matrix spikes. The material will be checked for legibility, completeness, correctness and the presence of requisite dates, initials, and signatures. The results of these checks will be assessed and reported to the project managers noting any discrepancies

and their effect upon the acceptability of the data. All information garnered for QA/QC checks will be discussed in a Data Quality Assessment and Validation report.

Validation of the analytical data will be performed by the CRA QA/QC Officer - Analytical Activities based on the relevant QC criteria outlined in "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses", February 1, 1988 and "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses", October 1989. Assessment of analytical and field data will include checks for data consistency by looking for comparability of duplicate analyses, potential sample contamination as indicated by results of field blank sample analyses, laboratory QA procedures, adherence to accuracy and precision criteria, transmittal errors and anomalously high or low parameter values. The results of these data validations will be reported to the project manager, noting any discrepancy and their effect upon usability of the data.

Raw data from field measurements and sample collection activities that are used in the project reports will be appropriately identified and appended to the report. Where field data have been reduced or summarized, the method of reduction will be documented in the report. In addition, field data will be audited for anomalously high or low values that may appear to be inconsistent with other data.

All data packages provided by the laboratories will consist of the following deliverables:

- i) a case narrative that includes a summary of analytical methods used and a description of any unusual action or conditions;
- ii) dates of sample receipt, extraction/digestion and analysis;
- iii) method blank sample summaries;
- iv) surrogate compound recovery data and matrix spike/matrix spike duplicate recovery data and control limits (for organics);

- v) matrix spike recovery data and duplicate sample analysis data and control limits (for inorganics);
- vi) laboratory control spike/laboratory control spike duplicate recovery data and control limits (for air samples);
- vii) check sample data; and
- viii) executed chain-of-custody records.

The data packages will be stored with the evidentiary files as described in Section H.2.6.4.

H.2.11.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analyses are performed in accordance with the procedures established in Section H.2.5.0. The audits of field and laboratory activities include two separate independent parts: internal and external audits.

H.2.11.1 FIELD AUDITS

Internal audits of field activities (sampling and measurements) will be conducted by the CRA QA/QC Officer - Field Activities. The audits will include examination of field sampling records, field instrument operating records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures and chain-of-custody. These audits will be conducted to correct deficiencies and to verify that QA procedures are maintained throughout the RI/FS. The audits will involve review of field measurement records, instrumentation calibration records and sample documentation.

Any external audits may be conducted by IDEM, as required.

H.2.11.2 LABORATORY AUDITS

The internal performance and system audits of the laboratories may be conducted by the CRA QA/QC Officer-Analytical Activities. The system audits, which will be conducted as deemed necessary by the CRA project manager or the CRA QA/QC Officer - Analytical Activities, will include examination of laboratory documentation of sample receiving, sample log-in, sample storage, chain-of-custody procedure, sample preparation and analysis and instrument operating records. The performance audits may be conducted on a quarterly basis. Blind QC samples will be prepared and submitted along with project samples to the laboratory for

analysis throughout the project. The QA officer will evaluate the analytical results of these blind performance samples to ensure the laboratory maintains acceptable performance.

Any external audits may be conducted by IDEM, as required.

H.2.12.0 PREVENTIVE MAINTENANCE

All analytical instruments to be used in this project will be serviced by the laboratory personnel at regularly scheduled intervals in accordance with the manufacturer's recommendations. Instruments may also be serviced at other times due to failure. Requisite servicing beyond the abilities of the laboratory personnel will be performed by the equipment manufacturer or its designated representative.

Daily checks of each instrument will be performed by the analyst who has been assigned responsibility for that instrument. The manufacturer's recommended procedures will be followed in every case. Table H.2.12 presents routine preventive maintenance for laboratory and field instruments.

The pH, conductivity, methane gas, hydrogen sulfide and hydrogen cyanide meters will be calibrated in the field as described in the SOPs in Attachment H.2-1. In addition, the following preventive maintenance measures will be taken in the field:

Water Level Tape - Clean probe and lower three feet of tape with Alconox™ detergent wash and deionized water rinse to prevent hard water and iron buildup.

H.2.13.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

The following sections include the procedures and formulae utilized to assess the levels of precision, accuracy and completeness achieved during the associated sample analyses.

H.2.13.1 FIELD MEASUREMENTS

Field data will be assessed by the CRA QA/QC Officer - Field Activities for compliance with the established QC criteria that are specified in the QAPP. Accuracy of the field measurements will be assessed using daily instrument calibration, calibration check and analysis of blanks. Precision will be assessed on the basis of reproducibility by duplicate readings of a single sample. Data completeness will be calculated using the following equation:

$$\text{Completeness} = \frac{\text{Valid (usable) Data Obtained}}{\text{Total Data Planned}} \times 100$$

The required level of completeness will be 80 percent.

H.2.13.2 LABORATORY DATA

Laboratory results will be assessed for compliance with the required precision, accuracy, completeness and sensitivity as follows:

H.2.13.2.1 Precision

Precision of laboratory analysis will be assessed by comparing the analytical results of MS/MSD samples for organic analyses, LCS/LCSD samples for air analyses and laboratory duplicate analyses for

inorganic analyses. The relative percent difference (%RPD) will be calculated for each pair of duplicate analyses using the formula in Figure H.2.2.

H.2.13.2.2 Accuracy

Accuracy of laboratory results will be assessed for compliance with the established QC criteria that are described in Sections H.2.4.0 and H.2.9.0 of the QAPP using the analytical results of method blanks, reagent/preparation blanks, MS/MSD, MS/DUP and LCS/LCSD samples, field blanks and trip blanks. The percent recovery (%R) of matrix spike samples will be calculated using the formula in Figure H.2.2.

H.2.13.2.3 Completeness

Completeness will be assessed by comparing the number of valid (usable) results (as determined by CRA QA/QC Officer - Analytical Activities) to the total possible number of results using the formula presented in Section H.2.13.1. The required level of completeness for laboratory analyses will be 80 percent or greater.

H.2.13.2.4 Sensitivity

The achievement of targeted quantitation limits depend on instrumental sensitivity and matrix effects. Therefore, it is important to monitor the instrumental sensitivity to ensure the data quality through consistent instrument performance. The instrumental sensitivity will be monitored through the analysis of method blanks and calibration check samples.

Equation 1 Determination of Arithmetic Mean (\bar{X})

$$\bar{X} = \frac{\sum_{i=1}^n X_i}{n}$$

where n = number of measurements

X_i = value of measurements

Equation 2 Determination of Standard Deviation (σ_{n-1})

$$\sigma_{n-1} = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n - 1}}$$

where n = number of measurements

X_i = value of measurements

\bar{X} = arithmetic mean

Equation 3 Determination of Percent Relative Standard Deviation (% RSD)

$$\% \text{ RSD} = \frac{\sigma_{n-1}}{\bar{X}} \times 100$$

where σ_{n-1} = standard deviation

\bar{X} = arithmetic mean

Equation 4 Determination of Percent Recovery (% R)

$$\% \text{ R} = \frac{\text{SSR} - \text{SR}}{\text{SA}} \times 100$$

where SSR = Spiked Sample Result

SR = Sample Result or Background

SA = Spike Added

Equation 5 Determination of Relative Percent Difference (RPD)

$$\text{RPD} = \left(\frac{|R_1 - R_2|}{\left[\frac{R_1 + R_2}{2} \right]} \right) \times 100$$

where R_1 = value of first result

R_2 = value of second result

figure H.2.2
STATISTICAL FORMULAE
FOUR COUNTY LANDFILL SITE
Fulton County, Indiana

H.2.13.3 STATISTICAL EVALUATIONS

In the evaluation of data and determination of precision and accuracy, standard statistical formulae will be used.

H.2.13.3.1 Arithmetic Mean

The arithmetic mean is the average obtained by dividing a sum by the number of its addends. A number of recovery results are averaged together to improve the accuracy of the measurement. Figure H.2.2, equation 1 summarizes the formula to be used to determine the arithmetic mean.

H.2.13.3.2 Standard Deviation

The standard deviation is the square root of the average squared difference between the individual values and the average value. A number of recovery results are evaluated to find the numerical variation in the data which is then used in the determination of the percent relative standard deviation. Figure H.2.2, equation 2 summarizes the formula to be used to determine the standard deviation.

H.2.13.3.3 Percent Relative Standard Deviation (%RSD)

The percent relative standard deviation is obtained by dividing the standard deviation of the values by the arithmetic mean of the values and multiplying by 100. The %RSD is calculated on a series of measurements to evaluate an instrument's analytical precision (e.g., initial calibration). Figure H.2.2, equation 3 summarizes the formula to be used to determine %RSD.

H.2.13.3.4 Percent Recovery (%R)

The percent recovery of a parameter is obtained by dividing the amount recovered by the true amount added and multiplying by 100. The percent recoveries of spiked samples are evaluated to establish the analytical accuracy of a measurement. Figure H.2.2, equation 4 summarizes the formula to be used to determine the percent recovery.

H.2.13.3.5 Relative Percent Difference (RPD)

The relative percent difference is obtained by dividing the difference between two numbers by their arithmetic mean and multiplying by 100. The RPD is used to evaluate the analytical precision of two replicate measurements (e.g., matrix spike/matrix spike duplicate). Figure H.2.2, equation 5 summarizes the formula to be used to determine RPD.

H.2.14.0 CORRECTIVE ACTION

The need for corrective action may be identified by system or performance audits or by standard QC procedures. The essential steps in the corrective action system will be:

1. checking the predetermined limits for data acceptability beyond which corrective action is required;
2. identifying and defining problems;
3. assigning responsibility for investigating the problem;
4. investigating and determining the cause of the problem;
5. determining a corrective action to eliminate the problem (this may include reanalyses or resampling and analyses);
6. assigning and accepting responsibility for implementing the corrective action;
7. implementing the corrective action and evaluating the effectiveness;
8. verifying that the corrective action has eliminated the problem; and
9. documenting the corrective action taken.

For each measurement system, the analyst will be responsible for identifying the need for corrective action and initiating the corrective action procedure. The laboratory supervisor will be responsible for implementing the corrective action and evaluating its effectiveness. The laboratory QA Officer will be responsible for documenting the fact that the corrective action has resolved the problem. The corrective action taken will depend upon the QA/QC criteria that did not meet the necessary criteria, and

may range from qualifying the data to resampling at the Site. All problems requiring corrective action and the corrective action employed to resolve the problem will be reported. Field corrective action will consist of instrument recalibration, replacement of probes or the instruments and will be documented in the field logbook.

H.2.15.0 QUALITY ASSURANCE REPORT TO MANAGEMENT

Management will receive reports on the performance of the measurement system and data quality following each sampling round and at the conclusion of the project.

Minimally, these reports will include:

1. assessment of measurement quality indicators, i.e., data accuracy, precision and completeness;
2. results of system audits; and
3. QA problems, action taken and resolutions.

The CRA QA/QC Officer - Analytical Activities will be responsible within the organizational structure for preparing these reports. The final report for the project will also include a separate QA section which will summarize data quality information contained in the periodic QA/QC reports to management, and details an overall data assessment and validation in accordance with the data quality objectives outlined in this QAPP.

ATTACHMENT H.2-1

STANDARD OPERATING PROCEDURES (SOP)
FIELD AND LABORATORY INSTRUMENTATION

I. FIELD SOPs		
A.	pH/Temperature	SOP No. PHT-CRA-3
B.	Specific Conductivity	SOP No. SC-CRA-93
C.	Hydrogen Sulfide	
D.	Methane Gas	
E.	Hydrogen Cyanide	
II. LABORATORY SOPs		
A.	Chain-of-Custody	SOP No. LO-13.0
B.	Maintenance and Tracking of Sample Custody	SOP No. OP-8.0
C.	Reagent and Chemical Handling and Standard Solution Preparation	SOP No. O-1.0
D.	Washing and Storing Glassware and Other Laboratory Equipment	SOP No. O-2.0
E.	Monitoring, Maintenance and Use of Milli-Q-Water Purification System	SOP No. FA-5.0
F.	Maintenance and Monitoring of the Central Deionized Water System	SOP No. F-4.0
G.	Calculations and Significant Figures	SOP No. D-6.0
H.	Defining QC Reporting Types	SOP No. Q-3.0
I.	Analytical Standard Operating Procedures and Analyst Training for Analysis of Volatile Organic Compounds by GC/MS	SOP No. MS-5
J.	Analytical Standard Operating Procedures and Analyst Training for Analysis of Semivolatile Organic Compounds	SOP No. MS-6
K.	PCB/Pesticide Analysis by GC/ECD	
L.	Chlorinated Herbicide Analysis by GC/ECD	
M.	Water Digestion for Analysis by FAA or ICP	SOP No. AM 200
N.	Aqueous Sample Preparation for Analysis by FAA or ICP	SOP No. AM 201
O.	Aqueous Sample Preparation for Analysis by GFAA	SOP No. AM 202
P.	Acid Digestion of Oils for Analysis by FAA, GFAA and ICP	SOP No. AM 203
Q.	Solid Sample Digestion for Analysis by FAA, GFAA and ICP	SOP No. AM 204
R.	GFAA Analysis	SOP No. M-10-12.0
S.	ICP Theory	SOP No. M-10-13.0
T.	Mercury Sample Preparation for Analysis by CVAA	SOP No. AM 205
U.	CVAA Mercury Determination in Water and Solid Samples	SOP No. M-10-19.0
V.	Cyanide Distillation	SOP No. GN-10-16.0

W. Cyanides, Amenable to Chlorination
X. Total Cyanide Analysis
Y. pH Determination
Z. Total Dissolved Solids
AA. Total Suspended Solids
BB. Alkalinity
CC. Chloride Analysis
DD. Chloride Argentometric
EE. Ammonia Nitrogen Distillation
FF. Nitrogen, Ammonia
GG. Nitrogen, Nitrate-Nitrite Analysis
HH. Sulfate Turbidimetric
II. Biochemical Oxygen Demand
JJ. Chemical Oxygen Demand
KK. TO-14 VOC

SOP No. AM 206

SOP No. GN-10-10.0

TABLE H.2.1

**SUMMARY OF SAMPLING AND ANALYSIS PROGRAM¹
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA**

<i>Sample Matrix</i>	<i>Field Parameters</i>	<i>Laboratory Parameters²</i>	<i>Investigative Samples</i>	<i>Field Blanks</i>	<i>Field Duplicates</i>	<i>Matrix Spike MS/MSD³</i>	<i>Total</i>
Groundwater (first round)	pH specific conductivity temperature water level	TCL VOC, TCL SVOC, TAL total and dissolved metals, TAL cyanide, pH, sulfate, chloride, nitrate, ammonia, TDS, TSS, alkalinity	71	8	8	4	95
Groundwater (second round)	pH specific conductivity temperature water level	Full Appendix IX BOD, COD	TBD ⁴	1/10 ⁵	1/10	1/20 ⁶	TBD
Sediment		TCL VOC, TCL SVOC TCL Pesticides/PCB, TAL Metals, TAL Cyanide, TOC	20	2	2	1	26
Surface Water	pH specific conductivity temperature water level	TCL VOC, TCL SVOC TCL Pesticides/PCB, TAL Metals, TAL Cyanide	20	2	2	1	26
Air	H ₂ S, HCN, Methane	TO-14 VOC	20	0	2	0	22

¹ One trip blank, which consists of two analyte-free water filled 40-mL preserved glass vials for TCL VOC water samples, will be shipped with each cooler of TCL VOC water samples.

² TCL = Target Compound List

TAL = Target Analyte List

VOC = Volatile Organic Compounds

SVOC = Semivolatile Organic Compounds

PCB = Polychlorinated Biphenyls

TDS = Total Dissolved Solids

TSS = Total Suspended Solids

BOD = Biological Oxygen Demand

COD = Chemical Oxygen Demand

TOC = Total Organic Carbon

³ Matrix spike/matrix spike duplicate (MS/MSD) samples are required for organic analyses. Samples designated for MS/MSD analyses will be collected with extra volumes for aqueous samples, at a frequency of one per group of twenty (20) or fewer investigative samples. Triple the normal sample volumes will be collected for aqueous VOC samples and double the normal sample volumes will be collected for extractable organic samples. Inorganic analyses require one matrix spike/laboratory duplicate (MS/DUP) to be analyzed at a frequency of one per group of twenty (20) or fewer investigative samples.

⁴ To be determined based on results of the first round groundwater sampling.

⁵ One per 10 or fewer investigative samples.

⁶ One per 20 or fewer investigative samples.

TABLE H.2.2

**LEVELS OF DATA QUALITY OBJECTIVES
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA**

<i>Matrix</i>	<i>Analysis</i> ¹	<i>DQO</i>
Groundwater	TCL VOC	Level III
	TCL SVOC	Level III
	TAL Total and Dissolved Metals	Level III
	TAL Cyanide	Level III
	pH (laboratory)	Level III
	Sulfate	Level III
	Chloride	Level III
	Nitrate	Level III
	Ammonia	Level III
	TDS	Level III
	TSS	Level III
	Alkalinity	Level III
	BOD	Level III
	COD	Level III
	Full Appendix IX	Level III
	Specific Conductivity	Level I
	Water Level	Level I
	Temperature	Level I
	pH	Level I
Sediment	TCL VOC	Level III
	TCL SVOC	Level III
	TCL Pesticides/PCB	Level III
	TAL Metals	Level III
	TAL Cyanide	Level III
	TOC	Level III
Surface Water	TCL VOC	Level III
	TCL SVOC	Level III
	TCL Pesticides/PCB	Level III
	TAL Metals	Level III
	TAL Cyanide	Level III
	Specific Conductivity	Level I
	Water Level	Level I
	Temperature	Level I
	pH	Level I
Air	VOC	Level III

¹

TCL = Target Compound List
 TAL = Target Analyte List
 VOC = Volatile Organic Compounds
 SVOC = Semivolatile Organic Compounds
 PCB = Polychlorinated biphenyls
 TDS = Total Dissolved Solids
 TSS = Total Suspended Solids
 BOD = Biological Oxygen Demand
 COD = Chemical Oxygen Demand
 TOC = Total Organic Carbon

TABLE H.2.3
TARGETED QUANTITATION LIMITS FOR TCL VOLATILE
ORGANIC COMPOUNDS ANALYSIS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Cas No.	Compound	Targeted Quantitation Limits ¹	
		Water (µg/L)	Sediment (µg/kg) ²
TCL Volatile Organic Compounds			
67-64-1	acetone	10	50
71-43-2	benzene	1	5
75-27-4	bromodichloromethane	1	5
75-25-2	bromoform	1	5
74-83-9	bromomethane	1	10
78-93-3	butanone	10	50
75-15-0	carbon disulfide	1	5
56-23-5	carbon tetrachloride	1	5
108-90-7	chlorobenzene	1	5
75-00-3	chloroethane	1	10
67-66-3	chloroform	1	5
74-87-3	chloromethane	1	10
10061-01-15	cis-1,3-dichloropropene	1	5
124-48-1	dibromochloromethane	1	5
75-35-3	1,1-dichloroethane	1	5
107-06-2	1,2-dichloroethane	1	5
75-35-4	1,1-dichloroethene	1	5
540-59-0	1,2-dichloroethene (total)	1	5
78-87-5	1,2-dichloropropane	1	5
100-41-4	ethylbenzene	1	5
591-78-6	2-hexanone	10	50
75-09-2	methylene chloride	1	5
108-10-1	4-methyl-2-pentanone	10	50
100-42-5	styrene	1	5
79-34-5	1,1,2,2-tetrachloroethane	1	5
127-18-4	tetrachloroethene	1	5
108-88-3	toluene	1	5
10061-02-6	trans-1,3-dichloropropene	1	5
71-55-6	1,1,1-trichloroethane	1	5
79-00-5	1,1,2-trichloroethane	1	5
79-01-6	trichloroethene	1	5
75-01-4	vinyl chloride	1	10
1330-20-7	xylene (total)	1	5

¹ Actual sample quantitation limits are highly matrix dependent. Targeted quantitation limits presented are for guidance only.

² The targeted quantitation limits for sediment are based on wet weight. The data will be reported on a dry weight basis; therefore, the quantitation limits will be higher depending upon the percent moisture of each sample.

TABLE H.2.4

TARGETED QUANTITATION LIMITS FOR TCL
SEMIVOLATILE ORGANIC COMPOUNDS ANALYSIS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

CAS No.	Compound	Targeted Quantitation Limits	
		Water (µg/L)	Sediment (µg/kg)
TCL Semivolatile Organic Compounds			
83-32-9	acenaphthene	10	330
208-96-8	acenaphthylene	10	330
120-12-7	anthracene	10	330
56-55-3	benzo(a)anthracene	10	330
50-32-8	benzo(a)pyrene	10	330
205-99-2	benzo(b)fluoranthene	10	330
191-24-2	benzo(g,h,i)perylene	10	330
207-08-9	benzo(k)fluoranthene	10	330
111-91-1	bis(2-chloroethoxy)methane	10	330
111-44-4	bis(2-chloroethyl)ether	10	330
108-60-1	bis(2-chloroisopropyl)ether	10	330
117-81-7	bis(2-ethylhexyl)phthalate	10	330
85-68-7	butylbenzylphthalate	10	330
101-55-3	4-bromophenylphenyl ether	10	330
86-74-8	carbazole	10	330
106-47-8	4-chloroaniline	10	330
91-58-7	2-chloronaphthalene	10	330
7005-72-3	4-chlorophenyl phenyl ether	10	330
218-01-9	chrysene	10	330
53-70-3	dibenz(a,h)anthracene	10	330
132-64-9	dibenzofuran	10	330
95-50-1	1,2-dichlorobenzene	10	330
541-73-1	1,3-dichlorobenzene	10	330
106-46-7	1,4-dichlorobenzene	10	330
91-94-1	3,3'-dichlorobenzidine	50	660
84-66-2	diethylphthalate	10	330
131-11-3	dimethylphthalate	10	330
84-74-2	di-n-butylphthalate	10	330
117-84-0	di-n-octylphthalate	10	330
121-14-2	2,4-dinitrotoluene	10	330
606-20-2	2,6-dinitrotoluene	10	330
206-44-0	fluoranthene	10	330
86-73-7	fluorene	10	330
118-74-1	hexachlorobenzene	10	330
87-68-3	hexachlorobutadiene	10	330

TABLE H.2.4

TARGETED QUANTITATION LIMITS FOR TCL
SEMIVOLATILE ORGANIC COMPOUNDS ANALYSIS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

CAS No.	Compound	Targeted Quantitation Limits ¹	
		Water (µg/L)	Sediment ² (µg/kg)
77-47-4	hexachlorocyclopentadiene	10	330
67-72-1	hexachloroethane	10	330
193-39-5	indeno(1,2,3-cd)pyrene	10	330
78-59-1	isophorone	10	330
91-57-6	2-methylnaphthalene	10	330
91-20-3	naphthalene	10	330
88-74-4	2-nitroaniline	50	1,600
99-09-2	3-nitroaniline	50	1,600
100-01-6	4-nitroaniline	50	1,600
98-95-3	nitrobenzene	10	330
621-64-7	N-nitroso-di-n-propylamine	10	330
86-30-6	N-nitrosodiphenylamine (diphenylamine)	10	330
85-01-8	phenanthrene	10	330
129-00-0	pyrene	10	330
120-82-1	1,2,4-trichlorobenzene	10	330
59-50-7	4-chloro-3-methylphenol	10	330
95-57-8	2-chlorophenol	10	330
120-83-2	2,4-dichlorophenol	10	330
105-67-9	2,4-dimethylphenol	10	330
51-28-5	2,4-dinitrophenol	50	1,600
534-52-1	4,6-dinitro-2-methylphenol	50	1,600
95-48-7	2-methylphenol	10	330
106-44-5	4-methylphenol	10	330
88-75-5	2-nitrophenol	10	330
100-02-7	4-nitrophenol	50	1,600
87-86-5	pentachlorophenol	50	1,600
108-95-2	phenol	10	330
95-95-4	2,4,5-trichlorophenol	50	1,600
88-06-2	2,4,6-trichlorophenol	10	330

¹ Actual sample quantitation limits are highly matrix dependent. Targeted quantitation limits presented are for guidance only.

² The targeted quantitation limits for sediment are based on wet weight. The data will be reported on a dry weight basis; therefore, the quantitation limits will be higher depending upon the percent moisture of each sample.

TABLE H.2.5

TARGETED QUANTITATION LIMITS FOR TCL PESTICIDES/PCB
ORGANIC COMPOUNDS ANALYSIS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Cas No.	Compound	Targeted Quantitation Limits ¹	
		Water (µg/L)	Sediment ² (µg/kg)
TCL Pesticides/PCB			
319-84-6	alpha-BHC	0.05	1.7
319-85-7	beta-BHC	0.05	1.7
319-86-8	delta-BHC	0.05	1.7
58-89-9	gamma-BHC	0.05	1.7
76-44-8	heptachlor	0.05	1.7
309-00-2	aldrin	0.05	1.7
1024-57-3	heptachlor expoxide	0.05	1.7
959-98-8	endosulfan I	0.05	1.7
60-57-1	dieldrin	0.1	3.3
72-55-9	4,4'-DDE	0.1	3.3
72-20-8	endrin	0.1	3.3
33213-65-9	endosulfan II	0.1	3.3
72-54-8	4,4'-DDD	0.1	3.3
1031-07-8	endosulfan sulfate	0.1	3.3
50-29-3	4,4'-DDT	0.1	3.3
72-43-5	methoxychlor	0.5	17.0
53494-70-5	endrin ketone	0.1	3.3
7421-36-3	endrin aldehyde	0.1	3.3
5103-71-9	alpha-chlordane	0.5	1.7
5103-74-2	gamma-chlordane	0.5	1.7
8001-35-2	toxaphene	5.0	170.0
12674-11-2	PCB-1016	1.0	33.0
11104-28-2	PCB-1221	2.0	67.0
11141-16-5	PCB-1232	1.0	33.0
53469-21-9	PCB-1242	1.0	33.0
12672-29-6	PCB-1248	1.0	33.0
11097-69-1	PCB-1254	1.0	33.0
11096-82-5	PCB-1260	1.0	33.0

¹ Actual sample quantitation limits are highly matrix dependent. Targeted quantitation limits presented are for guidance only.

² The targeted quantitation limits for sediment are based on wet weight. The data will be reported on a dry weight basis; therefore, the quantitation limits will be higher depending upon the percent moisture of each sample.

TABLE H.2.6

**TARGETED QUANTITATION LIMITS FOR TAL INORGANICS ANALYSIS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA**

<i>TAL Inorganics</i>	<i>Targeted Quantitation Limits</i> ¹	
	<i>Water (µg/L)</i>	<i>Sediment</i> ² <i>(mg/kg)</i>
aluminum	200	40
antimony	60	12
arsenic	10	2
barium	200	40
beryllium	5	1
cadmium	5	1
calcium	5,000	1,000
chromium	10	2
cobalt	50	10
copper	25	5
iron	100	20
lead	3	0.6
magnesium	5,000	1,000
manganese	15	3
mercury	0.2	0.10
nickel	40	8
potassium	5,000	1,000
selenium	5	1
silver	10	2
sodium	5,000	1,000
thallium	10	2
vanadium	50	10
zinc	20	4
cyanide	10	2

¹ Actual sample quantitation limits are highly matrix dependent. Targeted quantitation limits presented are for guidance only.

² The targeted quantitation limits for sediment are based on wet weight. The data will be reported on a dry weight basis; therefore, the quantitation limits will be higher depending upon the percent moisture of each sample.

TABLE H.2.7

**TARGETED QUANTITATION LIMITS FOR
GENERAL CHEMISTRY ANALYSIS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA**

<i>General Chemistry Parameter</i>	<i>Targeted Quantitation Limits</i> ¹
	<i>Water (mg/L)</i>
<i>Groundwater</i>	
sulfate	5
chloride	5
nitrate	0.01
ammonia	0.10
TDS	10
TSS	1.0
alkalinity	1.0
BOD	1.0
COD	10
	<i>Targeted Quantitation Limit</i> ¹
	<i>Sediment</i> ² <i>(mg/kg)</i>
<i>Sediment</i>	
TOC	100

¹ Actual sample quantitation limits are highly matrix dependent. Targeted quantitation limits presented are for guidance only.

² The targeted quantitation limits for sediment are based on wet weight. The data will be reported on a dry weight basis; therefore, the quantitation limits will be higher depending upon the percent moisture of each sample.

TABLE H.2.8

**TARGETED QUANTITATION LIMITS FOR APPENDIX IX LIST PARAMETER LIST
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA**

	<i>Targeted Quantitation Limit</i> ¹
	<i>Water (µg/L)</i>
<i>Volatiles</i>	
Acetone	50
Acetonitrile	50
Acrolein	100
Acrylonitrile	70
Allyl chloride (3-chloropropene)	20
Benzene	5
Bromodichloromethane	5
Bromoform	10
Bromomethane	10
2-Butanone (MEK)	50
Carbon disulfide	5
Carbon tetrachloride	10
Chlorobenzene	5
Chloroethane	10
Chloroform	5
Chloromethane	10
Chloropropene (2-chlorobutadiene-1,3)	20
Dibromochloromethane	5
1,2-Dibromo-3-chloropropane (DBCP)	20
1,2-Dibromoethane (EDB)	20
Dibromomethane	5
trans-1,4-Dichloro-2-butene	20
Dichlorodifluoromethane	20
1,1-Dichloroethane	5
1,2-Dichloroethane	5
1,1-Dichloroethene	5
1,2-Dichloroethene (total)	5
1,2-Dichloropropane	5
cis-1,3-Dichloropropene	5
trans-1,3-Dichloropropene	5
1,4-Dioxane	1,000
Ethylbenzene	5
Ethyl methacrylate	20
Iodomethane	20
Isobutanol	1,000
2-Hexanone	50
Methacrylonitrile	20
Methylene chloride	5
Methyl methacrylate	20
4-Methyl-2-pentanone (MIBK)	50

TABLE H.2.8

**TARGETED QUANTITATION LIMITS FOR APPENDIX IX LIST PARAMETER LIST
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA**

	<i>Targeted Quantitation Limit</i> ¹
	<i>Water (µg/L)</i>
<i>Volatiles Continued</i>	
Propionitrile (Ethyl cyanide)	100
Styrene	5
1,1,1,2-Tetrachloroethane	5
1,1,2,2-Tetrachloroethane	5
Tetrachloroethene	5
Toluene	5
1,1,1-Trichloroethane	5
1,1,2-Trichloroethane	5
Trichloroethene	5
Trichlorofluoromethane	5
1,2,3-Trichloropropane	5
Vinyl acetate	50
Vinyl chloride	10
Xylenes (total)	5
<i>Semivolatiles</i>	
Acenaphthene	10
Acenaphthylene	10
Acetophenone	10
2-Acetylaminofluorene	20
4-Aminobiphenyl	50
Aniline	10
Anthracene	10
Aramite	50
Benzo(a)anthracene	10
Benzo(b)fluoranthene	10
Benzo(k)fluoranthene	10
Benzo(g,h,i)perylene	10
Benzo(a)pyrene	10
Benzyl alcohol	10
4-Bromophenyl phenyl ether	10
Butyl benzyl phthalate	10
4-Chloroaniline	10
Chlorobenzilate	10
bis(2-Chloroethoxy)methane	10
bis(2-Chloroethyl)ether	10
bis(2-Chloroisopropyl)ether	10
4-Chloro-3-methylphenol	10
2-Chloronaphthalene	10

TABLE H.2.8

TARGETED QUANTITATION LIMITS FOR APPENDIX IX LIST PARAMETER LIST
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

	<i>Targeted Quantitation Limit</i> ¹
	<i>Water (µg/L)</i>
<i>Semivolatiles Continued</i>	
2-Chlorophenol	10
4-Chlorophenyl phenyl ether	10
Chrysene	10
Diallate	10
Dibenz(a,h)anthracene	10
Dibenzofuran	10
Di-n-butyl phthalate	10
1,2-Dichlorobenzene	10
1,3-Dichlorobenzene	10
1,4-Dichlorobenzene	10
3,3'-Dichlorobenzidine	20
2,4-Dichlorophenol	10
2,6-Dichlorophenol	10
Diethyl phthalate	10
Dimethoate	10
p-Dimethylaminoazobenzene	10
7,12-Dimethylbenz(a)anthracene	20
3,3'-Dimethylbenzidine	20
a,a-Dimethylphenethylamine	10
2,4-Dimethylphenol	10
Dimethyl phthalate	10
1,3-Dinitrobenzene	10
4,6-Dinitro-2-methylphenol	50
2,4-Dinitrophenol	50
2,4-Dinitrotoluene	10
2,6-Dinitrotoluene	10
Dinoseb	10
Di-n-octyl phthalate	10
Diphenylamine	10
Disulfoton	10
bis(2-Ethylhexy)phthalate	10
Ethyl methanesulfonate	10
Ethyl parathion	10
Famphur	10
Fluoranthene	10
Fluorene	10
Hexachlorobenzene	10
Hexachlorobutadiene	10
Hexachlorocyclopentadiene	10
Hexachloroethane	10
Hexachlorophene	50

TABLE H.2.8

TARGETED QUANTITATION LIMITS FOR APPENDIX IX LIST PARAMETER LIST
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

	<i>Targeted Quantitation Limit</i> ¹
	<i>Water (µg/L)</i>
<i>Semivolatiles Continued</i>	
Hexachloropropene	200
Indeno (1,2,3-cd)pyrene	10
Isodrin	20
Isophorone	10
Isosafrole	10
Kepone	20
Methapyrilene	100
3-Methylcholanthrene	100
Methyl methanesulfonate	10
2-Methylnaphthalene	10
Methyl parathion	10
2-Methylphenol	10
4-Methylphenol	10
Naphthalene	10
1,4-Naphthoquinone	200
1-Naphthylamine	50
2-Naphthylamine	10
2-Nitroaniline	50
3-Nitroaniline	50
4-Nitroaniline	50
Nitrobenzene	10
2-Nitrophenol	10
4-Nitrophenol	50
4-Nitroquinoline-1-oxide	100
N-Nitroso-di-n-butylamine	10
N-Nitrosodiethylamine	10
N-Nitrosodimethylamine	10
N-Nitrosodiphenylamine	10
N-Nitroso-di-n-propylamine	10
N-Nitrosomethylethylamine	10
N-Nitrosomorpholine	10
N-Nitrosopiperidine	10
N-Nitrosopyrrolidine	10
5-Nitro-o-toluidine	10
Pentachlorobenzene	10
Pentachloroethane	50
Pentachloronitrobenzene	50
Pentachlorophenol	50
Phenacetin	50
Phenanthrene	10
Phenol	10

TABLE H.2.8

TARGETED QUANTITATION LIMITS FOR APPENDIX IX LIST PARAMETER LIST
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

	<i>Targeted Quantitation Limit</i> ¹
	<i>Water (µg/L)</i>
<i>Semivolatiles Continued</i>	
4-Phenylenediamine	50
Phorate (Thimet)	10
2-Picoline	50
Pronamide	20
Pyrene	10
Pyridine	50
Safrole	10
Sulfotepp	10
1,2,4,5-Tetrachlorobenzene	10
2,3,4,6-Tetrachlorophenol	50
Thionazin	10
2-Toluidine	10
1,2,4-Trichlorobenzene	10
2,4,5-Trichlorophenol	10
2,4,6-Trichlorophenol	10
0,0,0-Triethyl phosphorothioate	10
1,3,5-Trinitrobenzene	50
<i>Pesticides/PCBs</i>	
Aldrin	0.05
Aroclor 1016	0.5
Aroclor 1221	0.5
Aroclor 1232	0.5
Aroclor 1242	0.5
Aroclor 1248	0.5
Aroclor 1254	1
Aroclor 1260	1
alpha-BHC	0.05
beta-BHC	0.05
delta-BHC	0.05
gamma-BHC (Lindane)	0.05
Chlordane	0.5
4,4'-DDD	0.1
4,4'-DDE	0.1
4,4'-DDT	0.1
Dieldrin	0.1
Endosulfan I	0.05
Endosulfan II	0.1
Endosulfan sulfate	0.1

TABLE H.2.8

TARGETED QUANTITATION LIMITS FOR APPENDIX IX LIST PARAMETER LIST
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

	<i>Targeted Quantitation Limit</i> ¹
	<i>Water (µg/L)</i>
<i>Pesticides/PCBs continued</i>	
Endrin	0.1
Endrin aldehyde	0.1
Heptachlor	0.05
Heptachlor epoxide	0.05
Methoxychlor	0.5
Toxaphene	1
<i>Chlorinated Herbicides</i>	
2,4-D	10
2,4,5-T	1.0
2,4,5-TP (Silvex)	1.0
<i>Inorganics</i>	
Antimony	300
Barium	10
Beryllium	5
Cadmium	10
Chromium	20
Cobalt	50
Copper	10
Nickel	40
Silver	10
Tin	1,000
Vanadium	50
Zinc	50
Arsenic	5
Lead	3
Mercury	0.2
Thallium	10
Cyanide	10
Sulfide	1,000
Selenium	5

TABLE H.2.8

TARGETED QUANTITATION LIMITS FOR APPENDIX IX LIST PARAMETER LIST
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

	<i>Targeted Quantitation Limit</i> ¹
	<i>Water</i> (µg/L)
TCDD ²	
2,3,7,8-TCDD	100

¹ Actual sample quantitation limits are highly matrix dependent. Targeted quantitation limits presented are for guidance only. Targeted quantitation limits may be affected by moisture content, matrix interferences, QA/QC problems and high concentrations of target and non-target analytes.

² Sample specific quantitation limits will be calculated for 2,3,7,8-TCDD based upon the signal to noise ratio.

TABLE H.2.9

TARGETED QUANTITATION LIMITS FOR VOLATILE
ORGANIC COMPOUNDS IN AMBIENT AIR
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

<i>Compound</i>	<i>Targeted</i> ¹
	<u><i>Quantitation Limits</i></u> (ppbv) ²
Acetone	10
Benzyl chloride	2.0
Benzene	2.0
Bromomethane	2.0
Carbon tetrachloride	2.0
Chlorobenzene	2.0
Chloroethane	4.0
Chloromethane	4.0
cis-1,2-Dichloroethylene	2.0
cis-1,3-Dichloropropene	2.0
Dichlorodifluoromethane	2.0
Ethylbenzene	2.0
Hexachlorobutadiene	4.0
Xylenes (total)	4.0
Methylene chloride	2.0
Styrene	2.0
Tetrachloroethene	2.0
Toluene	2.0
trans-1,3-Dichloropropene	2.0
Trichloroethene	2.0
Trichlorofluoromethane	2.0
Vinyl chloride	2.0
1,1-Dichloroethane	2.0
1,2-Dichloroethene (total)	2.0
1,1-Dichloroethylene	2.0
1,2-Dibromoethane	2.0
1,2-Dichloro-1,1,2,2-tetrafluoroethane	2.0
1,2-Dichlorobenzene	2.0
1,2-Dichloroethane	2.0
1,2-Dichloropropane	2.0
1,3-Dichlorobenzene	2.0
1,4-Dichlorobenzene	2.0
1,1,1-Trichloroethane	2.0
1,1,2-Trichloro-1,2,2-trifluoroethane	2.0
1,1,2-Trichloroethane	2.0
1,2,4-Trichlorobenzene	4.0
1,2,4-Trimethylbenzene	2.0

TABLE H.2.9

TARGETED QUANTITATION LIMITS FOR VOLATILE
ORGANIC COMPOUNDS IN AMBIENT AIR
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

<i>Compound</i>	<i>Targeted</i> ¹
	<u><i>Quantitation Limits</i></u> (ppbv) ²
1,3,5-Trimethylbenzene	2.0
1,1,2,2-Tetrachloroethane	2.0
Carbon disulfide	10
Vinyl acetate	10
2-Butanone	10
Chloroform	2.0
Bromodichloromethane	2.0
4-Methyl-2-pentanone	4.0
2-Hexanone	4.0
Dibromochloromethane	2.0
1,2-Dibromoethane	2.0
Bromoform	2.0
4-Ethyltoluene	2.0

¹ Actual sample quantitation limits are highly matrix dependent. Targeted quantitation limits presented are for guidance only. Targeted quantitation limits may be affected by matrix interferences, QA/QC problems and high concentrations of target and non-target analytes.

² ppbv = parts per billion by volume

TABLE H.2.10

**CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA**

<i>Analyses</i>	<i>Sample Containers</i>	<i>Preservation</i>	<i>Maximum Holding Time from Sample Collection*</i>	<i>Volume of Sample</i>	<i>Shipping</i>	<i>Normal Packaging</i>
<u>Groundwater</u>						
TCDD	Two 1-liter amber glass bottles	Iced, 4 °C	30 days for extraction 45 days after extraction for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
TCL SVOC, Appendix IX SVOC, Appendix IX Pest/PCB, Appendix IX Herbicides	Two 1-liter amber glass bottles per analysis	Iced, 4° C	7 days for extraction 40 days after extraction for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
TCL VOC, Appendix IX VOC	Three 40-mL teflon lined septum vials per analysis	HCl to pH <2, Iced, 4 °C	14 days for analysis	Fill completely, no air bubbles	Federal Express Priority 1	Foam Liner
TAL Total Metals, TAL Dissolved Metals, Appendix IX Metals	One 1-liter plastic bottle per analysis	HNO ₃ to pH <2, Iced, 4 °C	6 months (mercury - 28 days) for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
TAL Cyanide	One 1-liter plastic bottle	NaOH to pH >12, Iced, 4 °C	14 days for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
BOD	One 1-liter polyethylene	Iced, 4 °C	48 hours to incubation	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
Total Suspended Solids, Total Dissolved Solids	One 1-liter polyethylene	Iced, 4 °C	7 days for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
Alkalinity, Chloride, Sulfate	One 1-liter polyethylene	Iced, 4 °C	28 days (Alkalinity 14 days) for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips

TABLE H.2.10

**CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA**

<i>Analyses</i>	<i>Sample Containers</i>	<i>Preservation</i>	<i>Maximum Holding Time from Sample Collection*</i>	<i>Volume of Sample</i>	<i>Shipping</i>	<i>Normal Packaging</i>
Ammonia, Nitrate, COD	One 1-liter polyethylene	H ₂ SO ₄ to pH<2 Iced, 4 °C	28 days for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
<u>Sediment</u>						
TCL SVOC, TCL Pesticides/PCB	One 8-ounce glass per analysis	Iced, 4 °C	14 days for extraction 40 days after extraction for analysis	Fill to shoulder of jar	Federal Express Priority 1	Bubble Wrap or Foam Chips
TCL VOC	One 4-ounce glass	Iced, 4 °C	14 days for analysis	Fill completely	Federal Express Priority 1	Bubble Wrap or Foam Chips
TAL Metals	One 16-ounce glass	Iced, 4 °C	6 months (mercury - 28 days) for analysis	Fill to shoulder of jar	Federal Express Priority 1	Bubble Wrap or Foam Chips
TAL Cyanide	No additional jar necessary	Iced, 4 °C	14 days for analysis	Fill to shoulder of jar	Federal Express Priority 1	Bubble Wrap or Foam Chips
TOC	One 4-ounce glass	Iced, 4 °C	28 days for analysis	Fill to shoulder of jar	Federal Express Priority 1	Bubble Wrap or Foam Chips
<u>Surface Water</u>						
TCL SVOC, TCL Pesticides/PCB	Two 1-liter amber glass bottles per analysis	Iced, 4 °C	7 days for extraction 40 days after extraction for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
TCL VOC	Three 40-mL teflon lined septum vials	HCl to pH <2, Iced, 4 °C	14 days for analysis	Fill completely, no air bubbles	Federal Express Priority 1	Foam Liner
TAL Metals	One 1-liter plastic bottle	HNO ₃ to pH <2, Iced, 4 °C	6 months (mercury - 28 days) for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips
TAL Cyanide	One 1-liter plastic bottle	NaOH to pH >12, Iced, 4 °C	14 days for analysis	Fill to neck of bottle	Federal Express Priority 1	Bubble Wrap or Foam Chips

TABLE H.2.10

**CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA**

<i>Analyses</i>	<i>Sample Containers</i>	<i>Preservation</i>	<i>Maximum Holding Time from Sample Collection*</i>	<i>Volume of Sample</i>	<i>Shipping</i>	<i>Normal Packaging</i>
<i>Air</i>						
VOC	6-liter Summa® Passivated Canister	None	14 days for analysis	Not Applicable	Federal Express Priority 1	Cannister Container

* - These are technical holding times; (i.e., are based on time elapsed from time of sample collection).

TABLE H.2.11
SUMMARY OF ANALYTICAL METHODS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

	<i>Parameter</i> ¹	<i>Analytical Methods</i>		<i>Preparatory Methods</i> ²
Groundwater	TCL VOC	SW-846	³ 8260A	
	TCL SVOC	SW-846	8270A	SW-846 3510A/3520A
	TAL Total and Dissolved Metals	SW-846	6010A/7000A series	SW-846 3010A/3020A
	TAL Cyanide	SW-846	9012	
	pH	USEPA	⁴ 150.1	
	Sulfate	USEPA	375.4	
	Chloride	USEPA	325.2	
	Nitrate	USEPA	352.1	
	Ammonia	USEPA	350.2	
	TDS	USEPA	160.1	
	TSS	USEPA	160.2	
	Alkalinity	USEPA	370.1	
	BOD	USEPA	405.1	
	COD	USEPA	410.1	
	Appendix IX VOC	SW-846	8240A	
	Appendix IX SVOC	SW-846	8270A	SW-846 3510A/3520A
	Appendix IX Pesticides/PCB	SW-846	8080A	SW-846 3510A/3520A
	Appendix IX Metals	SW-846	6010A/7000A series	SW-846 3010A/3520A
	Appendix IX Herbicides	SW-846	8150A	
	Appendix IX TCDD	SW-846	8290	
Sediment	TCL VOC	SW-846	8240A	
	TCL SVOC	SW-846	8270A	SW-846 3550A
	TCL Pesticides/PCB	SW-846	8080	SW-846 3550A
	TAL Metals	SW-846	6010/7000 series	SW-846 3050A
	TAL Cyanide	SW-846	9012	
	TOC	Walkley Black ⁵		
Surface Water	TCL VOC	SW-846	8260A	
	TCL SVOC	SW-846	8270A	SW-846 3510A/3520A
	TCL Pesticides/PCB	SW-846	8080	SW-846 3510A/3520A
	TAL Metals	SW-846	6010A/7000A series	SW-846 3010A/3020A
	TAL Cyanide	SW-846	9012	
Air	VOC	TO-14 ⁶		

¹

TCL = Target Compound List
TAL = Target Analyte List
VOC = Volatile Organic Compounds
SVOC = Semivolatile Organic Compounds
PCB = Polychlorinated Biphenyls
TDS = Total Dissolved Solids
TSS = Total Suspended Solids
BOD = Biological Oxygen Demand
COD = Chemical Oxygen Demand
TCDD = 2,3,7,8-Tetrachlorodibenzo-p-dioxin
TOC = Total Organic Carbon

²

Cleanup methods, if necessary, will be determined by the laboratory.

³

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA SW-846, 3rd edition, November 1986 and Update I, July 1992.

⁴

"Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, revised March 1983.

⁵

"Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties", American Society of Agronomy, 1965.

⁶

"Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air", EPA-600/4-79-041, April 1984.

TABLE H.2.12

**ROUTINE PREVENTIVE MAINTENANCE
PROCEDURES AND SCHEDULES
FOUR COUNTY LANDFILL
FYULTON COUNTY, INDIANA**

<i>Instrument</i>	<i>Maintenance Procedures/Schedule</i>	<i>Spare Parts in Stock</i>
Gas Chromatograph/Mass Spectrometer (GC/MS)	<ol style="list-style-type: none"> 1. Replace pump oil as needed. 2. Change septa weekly or as often as needed. 3. Change gas line dryers as needed. 4. Replace electron multiplier as often as needed. 5. Replace gas jet splitter as needed. 6. Replace GC injector glass liner weekly or as often as needed. 7. Replace GC column as needed. 8. Check to ensure the gas supply is sufficient for the day's activity and the delivery pressures are set as described in the SOP. 9. Check to ensure the pressure on the primary regulator never runs below 100 psi. 	<ol style="list-style-type: none"> 1. Syringes 2. Septa 3. Various electronic components 4. Glass jet splitter 5. GC column 6. Glass liner
Gas Chromatograph	<ol style="list-style-type: none"> 1. Change septa weekly or as often as needed. 2. Change gas line dryers as needed. 3. Replace GC injector glass liner weekly or as often as needed. 4. Replace GC column as needed. 5. Clean/replace GC detector as needed. 6. Check to ensure the gas supply is sufficient for the day's activity and the delivery pressures are set as described in the SOP. 7. Check to ensure the pressure on the primary regulator never runs below 100 psi. 	<ol style="list-style-type: none"> 1. Syringes 2. Septa 3. Detectors 4. Glass liner 5. GC column

TABLE H.2.12

**ROUTINE PREVENTIVE MAINTENANCE
PROCEDURES AND SCHEDULES
FOUR COUNTY LANDFILL
FYULTON COUNTY, INDIANA**

<i>Instrument</i>	<i>Maintenance Procedures/Schedule</i>	<i>Spare Parts in Stock</i>
Purge and Trap Sample Concentrator	<ol style="list-style-type: none"> 1. Replace trap as needed. 2. Decontaminate the system after running high concentration samples or as required by blank analysis. 3. Leak check system daily or as often as needed. 4. Check to ensure the gas supply is sufficient for the day's activity and the delivery pressures are set as described in the SOP. 5. Check to ensure the pressure on the primary regulator never runs below 100 psi. 	<ol style="list-style-type: none"> 1. Spare traps 2. Spare sparger 3. Various electronic components / circuits 4. Plumbing supplies - tubing fitting
Graphite Furnace Atomic Spectrophotomer (GFAA)	<ol style="list-style-type: none"> 1. Change graphite tube contact rings as needed. 2. Change D2 background correction lamp. 3. Clean quartz window as necessary. 4. Check to ensure the gas supply is sufficient for the day's activity and the delivery pressures are set as described in the SOP. 5. Check graphite tubes and replace as necessary. 	<ol style="list-style-type: none"> 1. Contact rings 2. D2 arc lamp
Mercury Analyzer	<ol style="list-style-type: none"> 1. Clean tubing and quartz cell weekly or as often as needed. 2. Clean aspirator as necessary. 3. Check to ensure the gas supply is sufficient for the day's activity and the delivery pressures are set as described in the SOP. 	<ol style="list-style-type: none"> 1. Quartz cells 2. Aspirator

TABLE H.2.12

**ROUTINE PREVENTIVE MAINTENANCE
PROCEDURES AND SCHEDULES
FOUR COUNTY LANDFILL
FYULTON COUNTY, INDIANA**

<i>Instrument</i>	<i>Maintenance Procedures/Schedule</i>	<i>Spare Parts in Stock</i>
Inductively Coupled Plasma Spectrometer (ICP)	<ol style="list-style-type: none"> 1. Clean torch assembly and mixing chamber when discolored or after eight hours of running high dissolved solid samples. 2. Clean nebulizer as needed. 3. Check to ensure the gas supply is sufficient for the day's activity and the delivery pressures are set as described in the SOP. 	<ol style="list-style-type: none"> 1. Spare torch mixing chambers 2. Spare nebulizer
pH Meter	<ol style="list-style-type: none"> 1. Check battery (if used in field); and replace if discharged. 2. After use in samples containing free oil, wash the electrode in soap and rinse thoroughly with water. Immerse the lower third of the electrode in diluted HCl (1:9) solution for 10 minutes to remove any film formed. Rinse thoroughly with water. 3. Keep electrode properly filled with appropriate filling electrolyte solution. 	<ol style="list-style-type: none"> 1. Standard buffers 2. Electrolyte filling solution 3. Spare electrodes
Specific Conductivity	<ol style="list-style-type: none"> 1. Check battery (if used in field); and replace if discharged. 2. After use in samples containing free oil, wash the electrode in soap and rinse thoroughly with water. 	<ol style="list-style-type: none"> 1. Standard solution 2. Spare electrodes

STANDARD OPERATING PROCEDURES
HYDROGEN SULFIDE



PassportTM Personal Alarm Instruction Manual

IMPORTANT WARNING

THIS MANUAL MUST BE CAREFULLY READ BY ALL INDIVIDUALS WHO HAVE OR WILL HAVE THE RESPONSIBILITY FOR USING OR SERVICING THE PRODUCT. Like any piece of complex equipment, the PASSPORT PERSONAL ALARM will perform as designed only if it is used and serviced in accordance with the manufacturer's instructions. OTHERWISE IT COULD FAIL TO PERFORM AS DESIGNED AND PERSONS WHO RELY ON THIS PRODUCT FOR THEIR SAFETY COULD SUSTAIN SEVERE PERSONAL INJURY OR DEATH.

The warranties made by Mine Safety Appliances Company with respect to the product are voided if the product is not used and serviced in accordance with the instructions in this manual. Please protect yourself and others by following them. We encourage our customers to write or call regarding this equipment prior to use or for any additional information relative to use or repairs.

In the U.S., to contact your nearest stocking location, dial toll-free 1-800-MSA-2222. To contact MSA International, dial 1-412-967-3000.

This manual pertains to instrument with Serial Number prefix "A."

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**MINE SAFETY APPLIANCES COMPANY, 1991
P.O. Box 426, Pittsburgh, Pennsylvania 15230**

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Chapter 1:

Safety & General Limitations

Certifications

Tests completed by MSA verify that the PassportTM Personal Alarm meets applicable industry and government standards (as of date of manufacture), including those for Electromagnetic Interference.

Electromagnetic Interference

This equipment has been type tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this

required to correct the interference at his own expense.

This equipment was tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio TV technician for help.

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

WARNING:

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

General Limitations & Warnings

The Passport Alarm detects gases and vapors in air only. It cannot measure combustible or toxic gases in:

- reducing atmospheres
- furnace stacks
- environments with inert gas backgrounds

Do not use the Passport Alarm to measure combustible or toxic gases when the amount of oxygen is:

- deficient
- enriched

The Passport Alarm measures combustible gases and vapors. It cannot measure the presence of combustible:

- airborne mists such as lubricating oils
- airborne dusts such as grain or coal dust

The Passport Alarm contains sensors which detect specific toxic gases. The instrument should be used to detect only those specific gases. Other toxic hazards may be present; the Passport Alarm is not intended to detect these other hazards.

Certain materials such as:

- silicone
- silicates
- lead-containing compounds

tend to desensitize the combustible gas sensor, thereby giving erroneously low readings. Calibration checks should be made frequently if such materials are suspected to be present in the tested atmosphere.

If you do not recalibrate, the instrument may give false readings and endanger life and health.

For best accuracy, calibrate at the pressure of intended use. Readings will be inaccurate if the Passport Alarm is used to take samples that are at:

- low atmospheric pressure
(below calibration pressure)
- high atmospheric pressure
(above calibration pressure)

Combustible gases will burn or explode only when the fuel/air mixture is within certain proportions. The minimum concentration of a particular combustible gas in air which can be ignited is defined as the Lower Explosive Limit (LEL). In some references, the term Lower Flammability Limit (LFL) is used.

Combustible gas readings with an **OVER** alarm in the display indicate an amount of gas which may be above the Lower Explosive Limit (LEL) or above 5% methane (CH₄) by volume. Such readings are beyond the accurate range of the sensor. (See Chapter 4 for limits.)

When sampling with accessory sampling lines, the shortest possible length should be used to minimize the time needed to obtain a valid reading.

When sampling over liquids, the end of the sampling line should not touch the surface of the liquid. Otherwise, liquids may enter the instrument, causing internal damage. In addition, sample gas may be blocked from entering the line, and a false reading may occur.

Obstruction of the sensor holes in the instrument case causes erroneous readings. These holes must be kept open at all times. Do not use compressed air to clean the sensor holes; excessive pressure at the face of the sensors could damage them.

Do not use MSA Lead Inhibitor Filters with this instrument. Loss of sensitivity may result.

Battery packs must be recharged in a non-hazardous location free of combustible gases and vapors.

Dispose of used batteries in accordance with local health and safety regulations.

A calibration check should be included as part of a routine inspection of this instrument to ensure it is operating properly and readings are accurate. See the Passport Portable Alarm Technical Manual for calibration procedure details and calibration kit part numbers.

Cautions

Acid gases, such as carbon dioxide, will shorten the service life of the oxygen sensor.

Do not push on the center of the oxygen or the toxic gas sensor. Be especially careful when installing or replacing a sensor. Damage to the sensor may result.

This instrument is designed for use only with the battery chargers listed in this manual. Use of other battery chargers may result in damage to the battery pack and instrument.

Use only genuine MSA replacement parts when performing any maintenance procedures described in this manual. Substitution of parts may seriously impair instrument performance, alter intrinsic safety characteristics, or void agency approvals.

Repair or alteration of the Passport Alarm beyond the procedures described in this manual could cause the instrument to fail to perform properly.

Chapter 2:

Using Your Passport Personal Alarm

It is your responsibility to know how to use the Passport Personal Alarm. When used properly, the Passport Alarm will alert you to the presence of combustible gases and vapors and to atmospheres that are rich or deficient in oxygen. It will also alert you to the presence of specific toxic gases if it is equipped with sensors for those gases. These conditions are displayed clearly and simultaneously on the face of the instrument.

Alarm levels are set at the factory and meet the most commonly accepted standards; see Chapter 4 for details. Setpoints can be changed to meet specific conditions.

Preparation

Battery Pack Installation

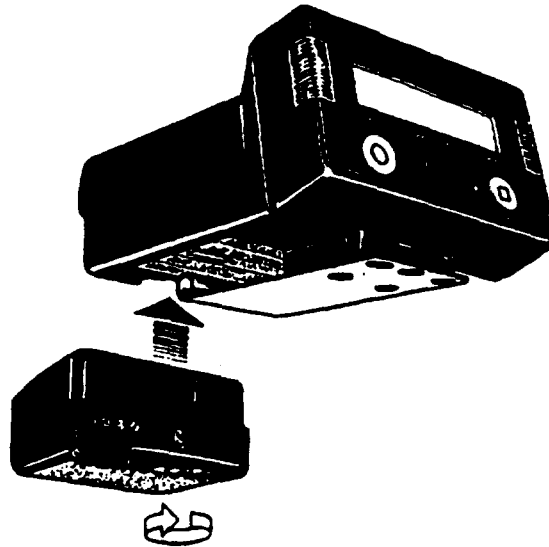


Figure 2-1. Battery Pack Installation

1. Slide the battery pack toward the sensor face of the instrument, and turn the "quarter-turn fastener" on the bottom of the instrument in a clockwise direction.
2. The instrument responds:
 - backlight flashes
 - screen flashes
 - alarm sounds
 - alarm lights flash

- major electronic components are tested automatically



Figure 2-2. Self Test

After tests are completed, either **ERROR** or **OK** appears on the display screen.

When **ERROR** appears:

- Alarm sounds; see the **Troubleshooting Guidelines** in the Passport Alarm Technical Manual.

When **OK** appears:

- Alarm sounds

- **POWER OFF** displays for a few seconds, and the instrument turns off.
- The Passport Alarm is ready for use after a calibration or response check is performed.

Turning On the Passport Personal Alarm

Push the **POWER** button.

- Display flashes and reads:

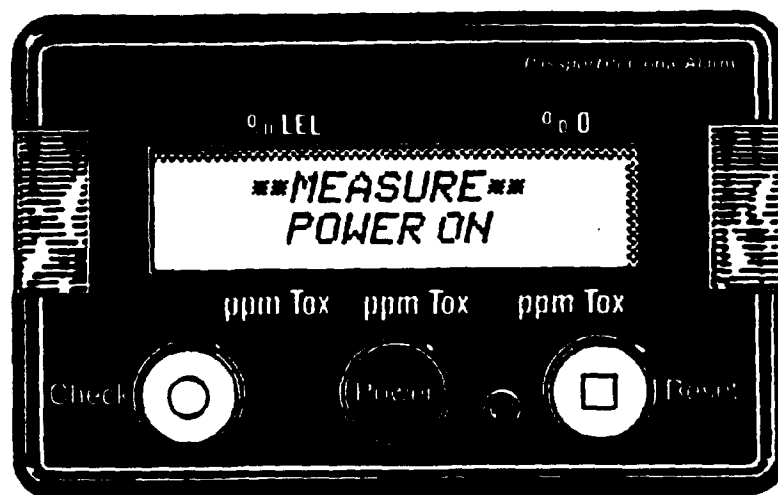


Figure 2-3. Measure: Power On

- Display backlight flashes
- Alarm lights flash
- Alarm sounds and stops
- Display reads:



Figure 2-4. Measure: Please Wait

If your instrument has the Fresh Air Setup (FAS) feature enabled, the combustible and toxic sensors can be zeroed, and the oxygen sensor can be spanned to 20.8%. FAS must only be used in fresh air. (See "Fresh Air Setup Option" later in this Chapter for additional information.)

Using the Passport Personal Alarm

The Passport Alarm has two standard and three optional display pages. You can move sequentially from one to the next by pressing the **CHECK** button. You can return to the standard Exposure display page by waiting for 15 seconds or by pressing the **POWER** button from another page.

The two standard display pages are:

- Exposure display (normal)
- Battery condition

The three optional display pages are:

- Peak readings
- Short Term Exposure Limit (STEL)
- Time Weighted Average (TWA)

If any of these optional display pages is enabled, it will appear on your instrument in the order shown above.

NOTE: The Passport Personal Alarm measures concentrations of gases no matter what display page is shown. When an alarm condition is reached, the alarm sounds automatically. The measurements made by the Passport Alarm are NOT dependent upon a specific display page being shown.

Exposure Display

In this normal display page, numbers appear near the gas labels on the instrument's display panel:

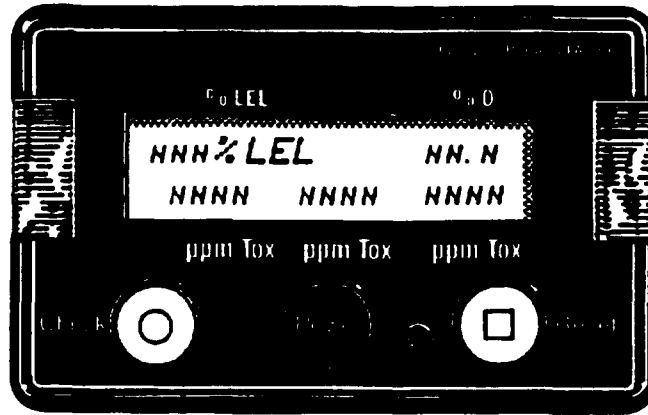


Figure 2-5. Exposure Page

To change from the Exposure display to the Battery Condition page, press the **CHECK** button.

Battery Condition

The display reads:

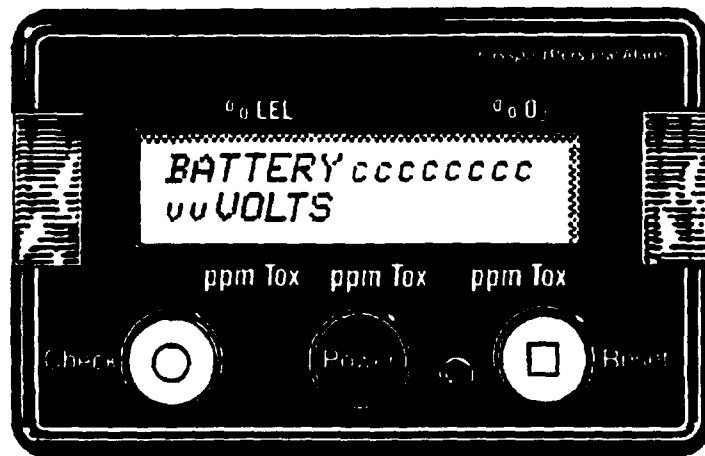


Figure 2-6. Battery Condition

- **v.v** is the voltage from the battery
- **cccc** is one of three battery conditions that can be displayed on the Battery display page:
 - **OK**: enough voltage to function properly
 - **LOW**: the battery will operate the Passport Alarm for approximately 30 more minutes; when the **LOW** battery condition is reached:
 - **BATT** appears in the Exposure Display Page
 - Alarm lights flash

- Alarm sounds
(Press the **RESET** button to silence it.)
- After initial **LOW** warning, the alarm sounds approximately every five minutes until the power is turned off or the battery condition is at **VERY LOW** level.
- **VERY LOW**: the battery is no longer able to operate the instrument, and:
 - **BATT** appears in the Exposure Display Page
 - Alarm sounds continuously and cannot be reset
 - After approximately five minutes the instrument shuts down automatically.

WARNING:

When the battery **VERY LOW** condition sounds, stop using the instrument. It cannot alert you of potential hazards because it does not have enough power to operate properly. You must:

1. Leave the area immediately.
2. Turn off the instrument if it is on.
3. Report to the person responsible for maintenance. Replace or recharge the battery pack.

If you do not follow this procedure, you could be injured or killed.

Calibration Check

The following calibration check should be performed before each day's use. This calibration check is very simple and should only take one to five minutes, depending on the number and type of gases your Passport Alarm is equipped to sense. Turn the Passport Alarm on in clean fresh air, and verify that the readings indicate no gas present. If necessary, perform the procedure given in "Fresh Air Setup Option" later in this Chapter.

1. Attach the pump module or calibration cap to the Passport Alarm, orienting the inlet fitting so that it points toward the battery pack.
2. Attach the calibration adapter (part no. 636246) to the calibration cap or pump module.
3. Attach the regulator supplied with the calibration kit to the cylinder.
4. Connect the black tubing supplied with the calibration kit to the regulator.
5. Open the valve on the regulator, and connect the other end of the tubing to the inlet fitting.

Chapter 2: Using Your Passport Personal Alarm

The flow rate of the regulator is 0.25 lpm. Note the readings on the Passport display; they should be within the limits stated on the calibration cylinder or limits determined by your company. (If necessary, change cylinders to introduce other calibration gases.)

If the readings are not within these limits, the Passport Alarm requires recalibration. Return the instrument to your maintenance facility, or refer to the Passport Personal Alarm Technical Manual, Chapter 2, "Calibration" for detailed calibration instructions.

This calibration procedure applies to calibration gases available in cylinders. For those calibration gases only available in ampoules, refer to the Passport Personal Alarm Technical Manual, Chapter 2, "Calibration."

Measuring Gas Concentrations

Combustible Gases (COMB)

The Passport Alarm detects combustible gases in the atmosphere. The Alarms sound when concentrations reach:

- Alarm setpoint, or
- 100% LEL (Lower Explosive Limit), or
- 5% CH₄ (Methane by volume)

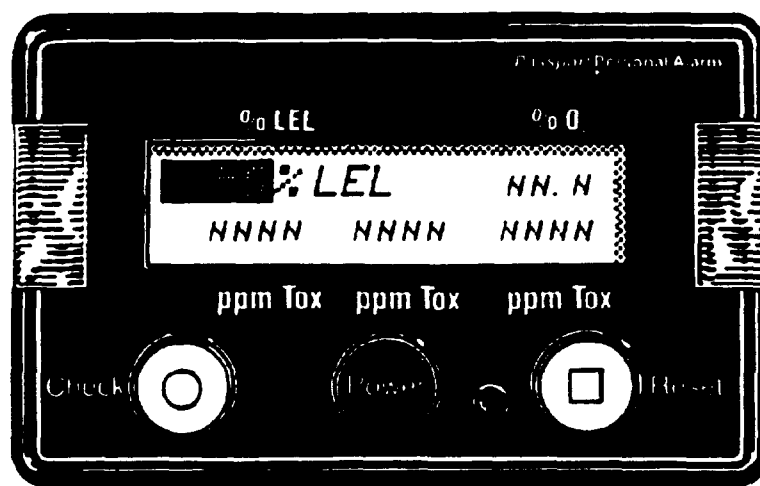


Figure 2-7. Combustible Gas Alarm Flag

When the combustible gas indication reaches the Alarm Setpoint:

- Alarm sounds
- Alarm lights flash;
Press the **RESET** button to silence the alarm.
- Concentration of gas flashes in the display

When the combustible gas indication reaches 100% LEL or 5% CH₄ of the combustible gas:

- Alarm sounds;
This alarm *cannot* be reset with the **RESET** button.

The alarm can be reset by turning off the instrument and moving to a safe, fresh-air environment.

WARNING:

When the OVER alarm condition is reached, you are in a life-threatening situation: there is enough gas in the atmosphere for an explosion to occur.

You must:

1. Leave the area immediately.
2. Turn off the instrument, and do not turn it on again until the instrument is in fresh air.

If you do not follow this procedure, you could be injured or killed.

Oxygen Measurements

The Passport Alarm detects the amount of oxygen in the atmosphere. There are two conditions which trigger the alarm:

- Too little oxygen (deficient)
- Too much oxygen (enriched)

At the Alarm Setpoint for either:

- Alarm sounds
- Alarm light flashes
- Concentration of gas flashes in the display



Figure 2-8. Oxygen Alarm Flag

WARNING:

When the OXYGEN alarm sounds, you may be in a life-threatening situation.

You must follow your company's work and safety procedures. If you do not follow those procedures you could be injured or killed.

Toxic Gas Measurement

The Passport Alarm detects certain toxic gases in the atmosphere. Your instrument may have one, two, or three toxic sensors. Each of these sensors has a setpoint which causes an alarm if the gas level goes above that setpoint. When this happens:

- Alarm sounds
- Alarm lights flash
- Concentration of gas flashes in the display

WARNING:

When the TOXIC GAS alarm sounds, you may be in a life-threatening situation.

You must follow your company's work and safety procedures. If you do not follow those procedures you could be injured or killed.

Options

Optional Displays

NOTE: The following display pages appear only if enabled by internal switches; see the Passport Alarm Technical Manual for instructions.

Press the **CHECK** button to move to:

Peak Readings

This shows the highest levels of gas that the Passport Alarm recorded since it was turned on or since the peak readings were reset.



Figure 2-10. Peak Readings

To reset the Peak Readings:

1. In Peak display, press the **RESET** button.

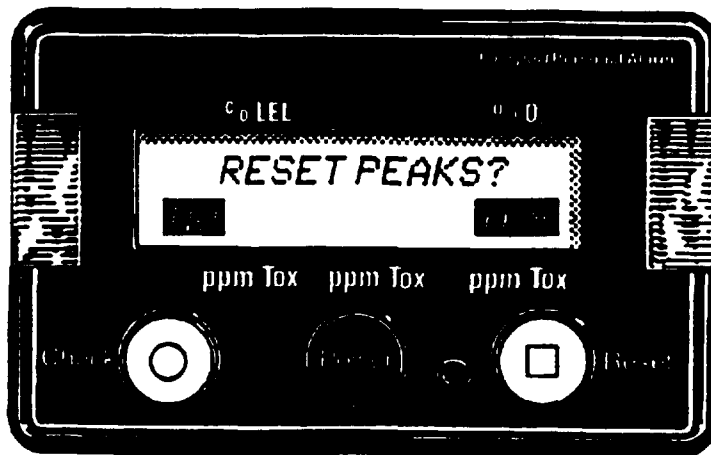


Figure 2-9. Reset Peak Readings

2. Press the **RESET** (YES) button to reset peak readings.

Press the **CHECK** (NO) button or wait 15 seconds to cancel.

Press the **CHECK** button to move to:

Short Term Exposure Limit (STEL)

This shows the average exposure over a 15 minute period.

When the amount of gas detected by the Passport Alarm is greater than the STEL limit:

- On the Exposure display page, the screen displays:

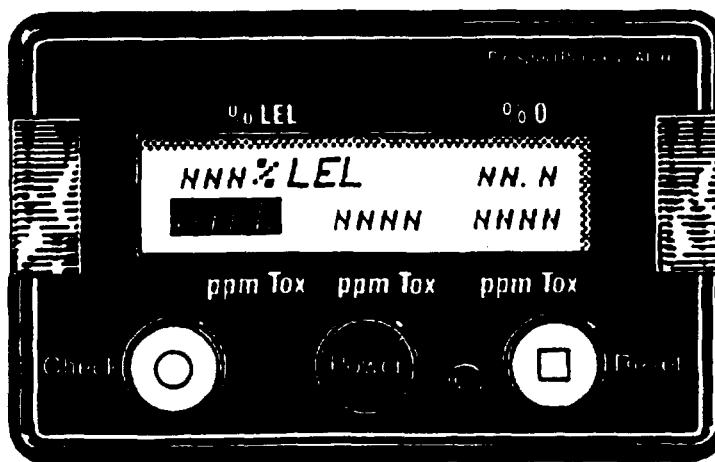


Figure 2-11. STEL Alarm Flag

- Alarm sounds
- Alarm lights flash

To reset the alarm:

- In the STEL display, press the **RESET** button.

WARNING:

When the STEL alarm sounds you may be exposed to a concentration of gas that is dangerous to your life and health.

You must follow your company's work and safety procedures. If you do not follow those procedures you could be injured or killed.

Press the **CHECK** button to move to:

Time Weighted Average (TWA)

TWA is the average exposure since the Passport Alarm was turned on. When the amount of gas detected by the Passport Alarm is greater than the eight hour TWA limit:

- Alarm sounds
- Alarm lights flash
- On the Exposure display page, the screen displays the TWA alarm flag.

To reset alarm:

- In the **TWA** display, press the **RESET** button.

WARNING:

When the TWA alarm sounds you may be exposed to a concentration of gas that is dangerous to your life and health.

You must follow your company's work and safety procedures. If you do not follow those procedures you could be injured or killed.

You may press the **CHECK** button to move to the Exposure display.

Optional Sampling Equipment

Sampling lines and related equipment permit samples of gas to be taken from remote or inaccessible locations.

Sampling lines are five to 50 feet long and are made of a synthetic material specifically compounded to resist adsorption of combustible and toxic vapors. Gases are drawn through the lines to the Passport Alarm by a pump.

Using the shortest possible line reduces the time the pump must run before valid samples and readings can be obtained.

Pump Module Option

When ordered, the pump module is packed separately and may be installed before using the Passport Alarm:

1. Position the pump module as shown.
2. Hand-tighten the screws until snug.

CAUTION:
Do not overtighten the screws.

Removing the Pump Module

1. Loosen screws.
2. Remove pump module.

Using Sampling Equipment:

1. Turn off the Passport Alarm.

2. Install the Pump Module if it is not already attached.
3. Attach the Sampling Hose to the Pump Module as shown.

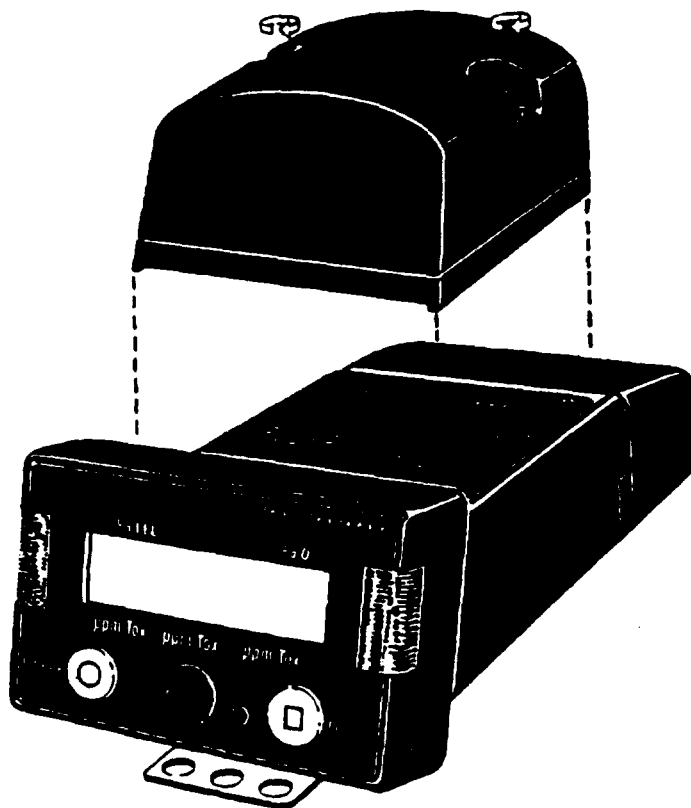


Figure 2-12. Pump Installation

4. Turn on the instrument, and verify proper operation:

- a. Plug the free end of the sampling line or probe. The pump motor shuts down and an alarm sounds. (The readings on the display may change.)

Periodically, the pump will try to restart. It cannot restart until the sampling line is opened. When the line is open the pump restarts automatically.

- b. Press the **RESET** button to reset the alarm.

CAUTION:

Never let the end of the sampling line touch or go under any liquid surface. If liquid is sucked into the instrument, readings will be inaccurate and the instrument could be damaged. We recommend the use of an MSA Sample Probe (part no. 497600, 800332, 800333, or equivalent) containing a special membrane filter, permeable to gas but impermeable to water, to prevent such an occurrence.

Removing Sampling Equipment

1. Turn off the Passport Alarm.
2. Unscrew the connector ring on the sampling line, and remove the sampling line.

Fresh Air Set Up Option

(for automatic zero adjustment of the Passport Alarm sensors)

WARNING:

Do not activate the fresh air setup unless you are certain you are in fresh, uncontaminated air; otherwise, inaccurate readings may occur. These inaccurate readings may falsely indicate that a hazardous atmosphere is safe, and injury or death could occur. If you have any doubts as to the quality of the surrounding air, do not use the fresh air setup feature.

When the display reads:

FRESH AIR SET UP?

NO

YES

The Passport Alarm is ready for its Fresh Air Set Up.



Figure 2-13. Fresh Air Set Up

To Proceed With Fresh Air Setup:

1. Press the **RESET (YES)** button; the display reads:

**FRESH AIR SET UP
PLEASE WAIT**

- a. When the display reads:

**FRESH AIR SET UP
ERROR - CANCELLED**

- Alarm sounds
- Lights flash

- 1) Push the **RESET** button.

- 2) Copy down the display message, and report to the person responsible for Passport Alarm maintenance. Do not use the instrument for protection.

b. When the Fresh Air Setup is completed:

- Instrument enters the Exposure display page and displays gas readings
- Instrument is ready for use

To Bypass The Fresh Air Set Up:

Press the **CHECK** (NO) button, or wait five seconds.

- Display enters Exposure page.
- Display begins to show gas readings.
- The instrument is ready for use.

Turning Off the Passport Alarm

Push the **POWER** button, and hold it for five seconds.
A countdown appears:

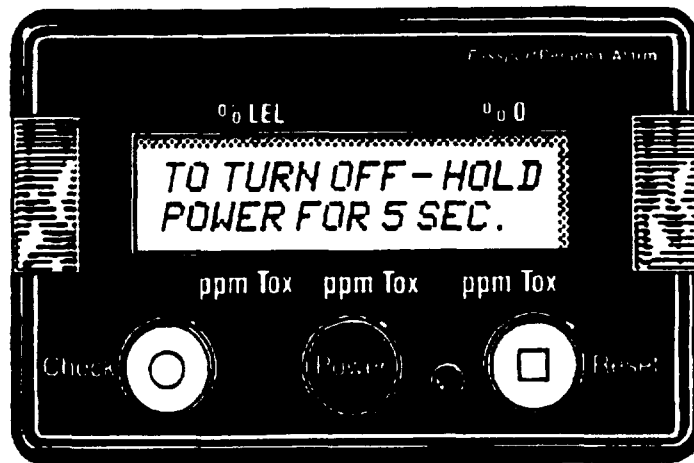


Figure 2-14. Power Down

Battery Pack Removal

1. Turn the power off by pressing and holding the **POWER** button for five seconds.
 - **POWER OFF** appears on the display.
2. Turn the "quarter-turn fastener" on the back of the instrument in a counterclockwise direction.
3. Slide the battery pack away from the sensor face.

Recharging Nickel-Cadmium (Ni-Cd) Battery Packs

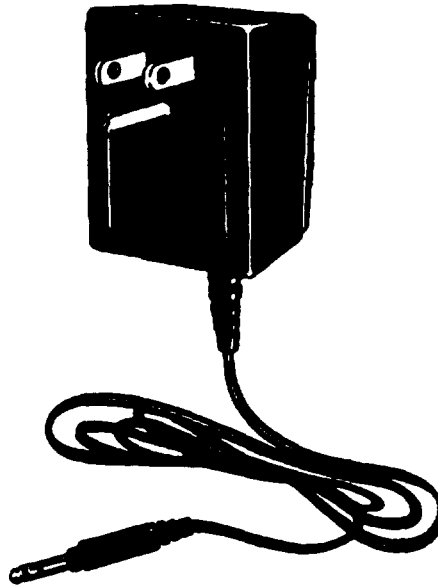


Figure 2-15. Ni-Cd Charger (U.S. version)

The battery pack may be charged when it is connected to the Passport Alarm or when it is removed. If the battery pack is connected to the Passport Alarm:

1. Turn off the instrument.
2. Insert the charger plug into the jack on the battery pack.
3. Plug the charger into a matching receptacle.

The red light on the charger turns on if the charger is properly connected. When fully charged, the standard-duty Ni-Cd battery pack operates the Passport Alarm for approximately eight hours.

Chapter 3:

General Maintenance

As with all electronic equipment, the Passport Alarm will operate only if it is cared for and maintained properly.

WARNING:

Repair or alteration of the Passport Alarm beyond the scope of these instructions by anyone other than a person authorized by MSA may void all warranties and approvals. Such repairs may also endanger persons who rely on this equipment for their safety or health. When needed, use only genuine MSA replacement parts.

Cleaning & Routine Care

The case of the Passport Alarm should be cleaned periodically with a soft cloth dampened with water. If any sensor holes on the front of the instrument are blocked with dirt, they must be cleaned:

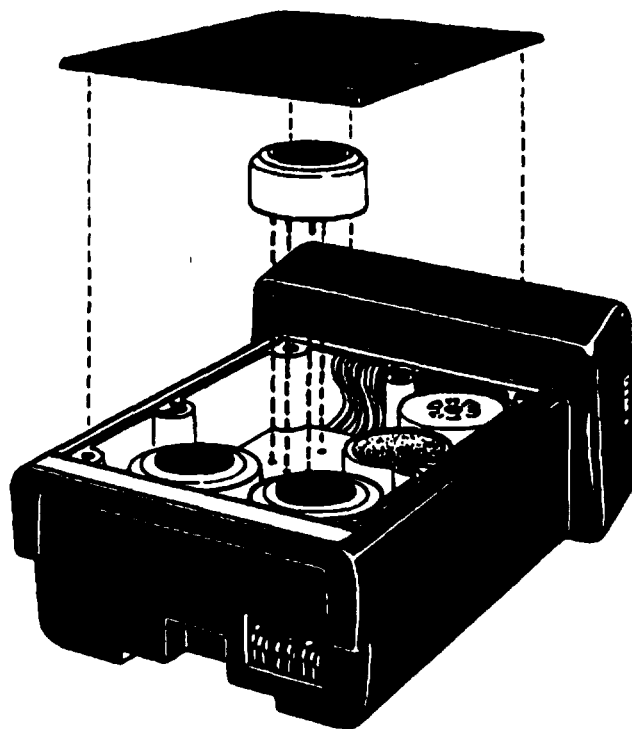


Figure 3-1. Sensor Cover Plate

1. Remove the sensor cover plate.
2. Clean the holes in the plate with a paper clip, wire, or similar device. The holes may also be cleaned with oil-free compressed air.

CAUTION:

Do not attempt to clean the sensor cover plate while it is in place; otherwise, the sensors may be damaged. The tops of sensors are very fragile. Do not touch or apply pressure to the tops of any sensors. If a sensor is damaged it may cause the instrument to give false readings.

The sensor cover plate contains holes for five sensors. In instruments with less than five sensors, some of these holes are permanently blocked with special sealing membranes. Do not puncture these membranes, or erroneous gas readings may result.

Storage

Store your Passport Alarm in a safe, dry place when it is not in use. Be sure that the storage area temperature is between 23 and 104 degrees Fahrenheit (-5 and 40 degrees Celsius).

- When the Passport Alarm is stored for more than one month, rechargeable battery packs should be periodically charged to prevent battery damage.

Storage for Models with Hydrogen Chloride (HCL) & Nitrous Oxide (NO) Sensors

These models draw a small amount of power at all times (even when turned off) in order to maintain a voltage on toxic gas sensors and keep them ready for immediate use.

- When the Passport Alarm is stored for less than 20 days, recharge the rechargeable battery pack or replace alkaline batteries before storing.
- To store these models for more than 20 days, attach the unit to a battery charger and charge with the proper MSA charger or periodically replace alkaline batteries with fresh cells once a year.

WARNING:

After storage, always recheck the calibration of the instrument before use. During storage, sensors may drift or become inoperative and may not provide warnings of danger to the health and lives of users.

Shipment

1. Remove the battery pack before shipment. When the Passport Alarm is returned for repairs, disconnect the normally used battery pack from the unit, and include it in the container.
2. Pack the Passport Alarm in its original shipping container with suitable padding. If the original container is unavailable, ask your MSA representative for a replacement. An equivalent container may be substituted if necessary. In either case, seal the instrument in a plastic bag to protect it from moisture. Protect the Passport Alarm from the rigors of handling with sufficient padding. Damage due to improper packaging or damage in shipment is not covered by the instrument's warranty.

Chapter 4:

Performance Specifications

Performance Specifications			
Combustible Gas	Range	0 to 100% LEL or	
		0 to 5% CH ₄	
	Resolution	1% LEL or	
		0.1% CH ₄	
	Reproducibility	3% LEL to 50% LEL reading	
		5% LEL to full scale or	
		0.2% CH ₄ to 2.5% Methane	
		0.3% CH ₄ to full scale	
	Response Time	90% of final reading in 30 seconds (normal temperature range)	
Oxygen	Range	0 to 25% O ₂	
	Resolution	0.1% O ₂	
	Reproducibility	0.3% O ₂ , for 2 to 25% O ₂	
	Response Time	90% of final reading	30 seconds (normal temperature range)
			3 minutes (extended temperature range)
Carbon Monoxide (appropriate models only)	Range	1000 ppm CO	
	Resolution	1 ppm CO	
	Reproducibility	±2 ppm CO or	
		10% of reading, whichever is greater	
	Response Time	90% of final reading in 40 seconds (normal temperature range)	
			continued →

Performance Specifications continued		
Hydrogen Sulfide (appropriate models only)	Range	50 ppm H ₂ S
	Resolution	1 ppm H ₂ S
	Reproducibility	±2 ppm H ₂ S or
		10% of reading, whichever is greater
	Response Time	90% of final reading in 65 seconds (normal temperature range)

Chapter 5:

Parts List

Chapter 5: Parts List

Table 5-1. Parts List	
PART	PART NO.
Pump Module	497430
Calibration Cap	497367
Battery Pack, Standard Ni-Cd Rechargeable	496990
Probe - 1 ft.	800332
Probe - 3 ft.	800333
Sampling Line - 5 ft.	497332
Sampling Line - 10 ft.	497333
Sampling Line - 15 ft.	497334
Sampling Line - 25 ft.	497335
Replacement Filter	801582
Charger, Omega 120 VAC	494716
Calibration Kit Model RP with 0.25 lm Regulator	477149
Calibration Gas - 50% LEL pentane simulant / 15% O ₂	478192
Calibration Gas - 50% LEL pentane simulant / 15% O ₂ ; 60 ppm CO	478191
Calibration Gas; 10 ppm H ₂ S	467898
Calibration Kit; Ampoule Type	471735
CL ₂ Ampoule	471745
HCL Ampoule	497306
HCN Ampoule	471747
SO ₂ Ampoule	485461
NO ₂ Ampoule	485462

Electrical Contact

494998

STANDARD OPERATING PROCEDURES
METHANE GAS

I. GENERAL DESCRIPTION

The Model NP-204, Natural Gas Indicator is a compact battery-operated portable instrument that can be used for taking an air sample and indicating the presence and concentration of combustible gas, particularly natural gas, for location of gas leaks. Samples of the air under test are drawn by means of a rubber aspirator bulb and analyzed for combustible gas content on a heated platinum filament in a Wheatstone bridge measuring circuit. A built in meter indicates natural gas content in units of explosibility and/or in percent by volume.

Power for operation of the instrument is provided by built-in dry cells or rechargeable nickel-cadmium batteries. A probe and extension hose permit withdrawal of samples from bar holes and other remote locations, and the instrument fits in a compact leather case with over-the-shoulder carrying strap.

The Model NP-204 Natural Gas Indicator is designed expressly for looking for gas leaks by the bar hole method. It is also suitable and recommended for testing tanks, manholes, vessels and other spaces to determine presence or absence of combustible gas in pressure cylinders, pipelines and other closed systems. It is a valuable aid to safety of operations wherever flammable gases or vapors are handled.

II. OPERATION

Before taking instrument on the job, check battery voltage. To check, put switch in VOLT ADJ position. Meter should rise to the "CHECK" position near top of scale. Lift and turn VOLT ADJ. control clockwise to determine maximum voltage setting. If it cannot be set beyond mark, batteries need recharging or replacement for full capacity. Do not attempt to use instrument at all if reading cannot be set up to mark.

If voltage is satisfactory, continue with next steps of preliminary adjustment as follows:

1. Confirm operation of %LEL pilot light/meter illuminating lamp.
2. With sample inlet in fresh air, squeeze bulb several times to flush out any remaining gas.
3. Check zero setting by turning switch to %LEL position. Meter should read close to zero. Lift and turn LEL ZERO knob to bring reading to exactly 0.
4. Couple sampling hose to instrument inlet on left hand end, and connect probe to end of hose.
5. Admit a sample of some combustible gas to end of probe, and confirm that meter rises upscale. Flush indicator with fresh air, and verify that reading returns to zero.

The maximum concentration allowable in a space where men are working or where welding operations are carried out is primarily a matter of local regulation and of judgment based on knowledge of conditions. A maximum reading of 10% or 20% is usually allowed. If 20% is selected, this is often spoken of as a factor of safety of 5, as the concentration must be increased five times before explosive conditions are reached.

- B. In the % GAS range, readings are taken directly in percent by volume of natural gas. The primary use of the 100% GAS range is in leak location from natural gas pipelines. Bar-holes are driven at intervals along the surface over a buried pipeline, and tested with the Model NP-204 on the % LEL range. A probe is inserted into the bar-hole and the bulb is squeezed 3 times. A gas reading indicates that some gas leakage exists.

As bar-holes progressively closer to the leak are tested, higher and higher readings are obtained. When readings over the range of the % LEL scale are obtained, switch to % GAS range and note reading. Any concentration up to 100% gas can be read in this way.

If a series of holes all give readings over 100% LEL, it is unnecessary to go through the % LEL step, and readings may be taken directly on the % GAS range.

Other gases, including propane and other petroleum vapors, can also be read on the % GAS range. The calibration generally will not be correct, but comparative readings may be made to determine changes in concentration or variations from one point to another.

IV. OPERATING PRINCIPLE

The Model NP-204 is essentially two instruments combined in one. It is a combustible gas indicator, using the catalytic detection principle to respond to flammable gases up to the lower explosive limit, and it is also a thermal conductivity indicator, using the cooling effect of natural gas to produce readings up to 100% by volume. Both detection methods employ the Wheatstone bridge measurement principle, and use the same batteries, meter and sampling system. The detection methods are discussed further below:

1. % LEL Range

This range uses a catalytic platinum filament, initially heated by the battery current to the point where it will cause catalytic oxidation of any combustible gases or vapors that come in contact with the active surface. This oxidation produces a definite heat of combustion, corresponding to the concentration of gas. The heat in turn produces an increase in temperature, hence in electrical resistance, of the filament. This resistance change produces a deflection on the meter, corresponding to gas concentration.

3. SPAN, "H". Response should be set to give a 100% GAS reading while sampling natural gas of the type to be detected. Connect probe to instrument, adjust voltage, turn to "H" range, check zero, then admit straight natural gas to indicator, either by forcing it through under its own pressure or by drawing it in from a container filled with gas. When sample system is full of gas, shut off flow of gas and adjust SPAN until meter reads 100%.

B. Filament Replacement

Two pairs of filaments are used in the Model NP-204: Catalytic filaments for the "L" range, and thermal conductivity filaments for the "H" range. Each pair consists of an active or measuring filament and a reference or compensating filament. The active and reference catalytic elements and the active thermal element are all housed within a sintered bronze porous metal cup, which acts as a flame arrestor to retain explosions when sampling explosive gas/air mixtures. The flame arrestor is installed within a cavity in the instrument housing, so that sample drawn into instrument will pass through the flame arrestor and reach the elements.

The reference thermal element is mounted outside the flame arrestor, so that when installed in the instrument it is enclosed in an isolated cavity and does not encounter the sample. All four elements and the flame arrestor are permanently assembled onto an anodized aluminum plate with holes in each corner, so that it can be retained within the instrument by means of four screws. Short wires with lugs are provided, to connect to terminals on the circuit board, and the wires and terminals are color-coded for proper connection.

The entire filament/flame arrestor assembly must be replaced as a unit, if any portion becomes defective or damaged. To replace:

1. Loosen the two panel hold-down screws; remove and invert top panel.
2. Loosen (do not remove) the six screws holding the terminals T1-T6 for the colored lead wires. Pull wires from terminals.
3. Remove four screws, one in each corner of plate.
4. Remove complete plate and filament/flame arrestor assembly. Inspect cavity and gasket, and be sure that cavity and incoming passage is clear and dry.
5. Install new filament/flame arrestor in same position, with gasket in place.

CAUTION: While handling the new assembly, be very careful not to touch or otherwise damage the exposed thermal reference filament. Line it up carefully with cavity in panel before pushing the assembly into position.

6. Connect lead wires to corresponding color-coded terminals and fasten screws securely. Be sure to observe color coding. Note that there are two red wires, T₂ and T₆ which electrically are connected in common. Each should be connected to the red-coded terminal, T₂ or T₆, that is most readily accessible.

1. Hose

The hose used is Teflon-lined, synthetic rubber-jacketed, and immune to absorption or attack by any combustible vapors or solvents. Keep hose clean and be sure that couplings make air-tight contact, checking occasionally by holding finger over hose inlet. Bulb should remain flattened after squeezing if there is no leak.

Extension hoses in various lengths are available. The standard No. 80-0015 and 80-0025 hoses are polyethylene-lined and suitable for natural gas and most hydrocarbon vapors. Consult factory for hose recommendation if aromatic or other solvent vapors are to be handled.

3. Aspirator Bulb and Outlet Fitting

Sample is drawn by squeezing the aspirator bulb, a rubber bulb with inlet and outlet check valves. This assembly normally requires no maintenance, but bulb should be inspected periodically for cracks, and valves should be checked for leakage. The entire assembly is readily replaced.

The bulb connects to a hose barb outlet fitting on right hand end of panel. The fitting may be unscrewed from panel, and the cavity into which it fits is packed with glass wool to provide an appropriate amount of flow resistance and thereby limit the amount of meter fluctuation produced as the bulb is pumped. This packing will eventually become loaded with dust, which will result in slow sampling. When this occurs, the glass wool can be picked out with a wire or pointed tool and new packing installed. Correct amount must be determined by trial.

E. Meter/Indicator Lamps

Either the % LEL or the % GAS lamp is on whenever the instrument is on. This indicates which range is in use, and provides illumination to permit reading meter in dark places. If lamp fails, it should be replaced as follows:

Remove four screws holding top plate to top panel. Take off top plate, exposing lamps. Unsolder lamp wires at terminals (or cut wire from % GAS lamp at the splice) and solder new lamp in the same position.

V. PRECAUTIONS AND NOTES ON OPERATION

A. Heated Samples

When sampling spaces such as hot tanks that are warmer than the instrument, remember that condensation can occur as the sample passes through the cool sample line. Water vapor condensed in this way can block the flow system and corrode the flame arrestor. A water trap can be used to control this, and is available as an accessory.

D. Oxygen Deficient Mixtures

Samples which do not have the normal proportion of oxygen may tend to read low on the % LEL range, if there is not enough oxygen to react with all combustible gas present in the sample. As a general rule, samples containing 10% oxygen or more have enough oxygen to give a full reading on any combustible gas sample up to the L.E.L.

Oxygen deficiency does not affect the % GAS range, since it does not depend on oxidation or combustion, but only on the cooling effect of the gas.

Instruments for measurement of oxygen concentration are available from Gas Tech Inc.

E. Oxygen - Enriched Mixtures

Samples having more than the normal proportion of oxygen will give a normal reading. However, they should be avoided because the flame arrestor used is not dense enough to arrest flames from combustible gas in oxygen, which can be much more intense than those in air. DO NOT ATTEMPT TO USE THE MODEL NP-204 ON SAMPLES OF COMBUSTIBLE GAS IN OXYGEN.

VII. ACCESSORIES

A. Probe

The standard probe supplied with the NP-204 is a 30" aluminum probe with holes cross-drilled 4" from the end, to prevent water from being drawn in if the end of probe is inadvertently immersed.

Other probes are available including a 30" fiberglass probe for electrical insulation, and a short (10") probe which is convenient in leak checking around meters and in confined spaces.

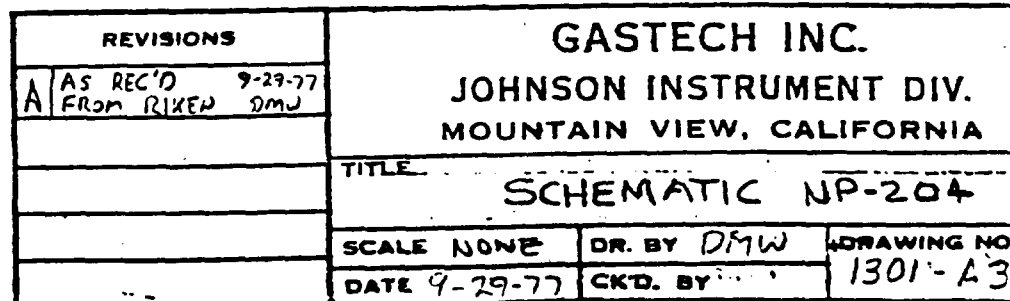
B. Extension Hoses

Additional lengths of hose may be used, up to approximately 50' for sampling from deep tanks and manholes. The polyethylene-lined hoses (80-0015 and 80-0025, see parts list) are satisfactory for most samples including natural gas, hydrogen, propane, and gasoline vapors. Some of the more complex hydrocarbons such as xylene and styrene, tend to be adsorbed on the walls of the polyethylene hose. For these samples, consult factory for the most appropriate hose selection.

VIII. PARTS LIST

The following parts are considered as normal repair or replacement items or accessories, and may be ordered separately, by description and stock number. Always specify model and serial number of instrument for which parts and accessories are required. For problems with parts not listed, write or telephone GasTech for information or request shipping instructions for return of the instrument for repair.

<u>Stock No.</u>	<u>Description</u>
51-0101	Lamp, meter illuminating
49-2011	Charger for NP-204, 120/240 volts AC
49-1201	Battery, alkaline, size D
49-1501	Battery, nickel-cadmium, size D
30-0410	Aspirator bulb with tube
80-0150	Probe with filter, 10" plastic
80-0155	Probe with filter, 30" aluminum
80-0156	Probe with filter, 30" fiberglass
80-0003	Hose, 3', Polyethylene, complete with couplings
80-0002	Hose, 6', Teflon-lined, complete with couplings
80-0015	Hose, 15', polyethylene-lined, complete with couplings
80-0025	Hose, 25' polyethylene-lined, complete with couplings
33-1031	Filter element, cotton, pkg. of 24
80-0200	Moisture trap, attachment
81-0202	Calibration Test Kit, 2.5% natural gas
81-0012	Cylinder, replacement, 2.5% natural gas
20-0201	Storage case, Model NP-204
62-0106	Filament/flame arrestor assembly, including catalytic and thermal conductivity filaments, wired and ready for installation



Operating and Maintenance Instructions for GasTech #80-0101 Minipump.

I. GENERAL DESCRIPTION

The GasTech #80-0101 minipump is a general purpose portable, battery-powered pump accessory primarily intended to replace the aspirator bulb in drawing samples through portable gas indicators. Specifications are:

Weight	: 19 oz.
Power	: Self contained nickel-cadmium battery, rechargeable.
Flow rate	: 2.5 cfh (approx.)
Operating Life	: 36 hours per battery charge.
Charger Voltage	: 115 VAC (Built-in)
Recharge time	: 16 hours
Accessories furnished	: Leather carrying case Charger linecord 10" rubber tubing for connection of pump to instrument.

II. OPERATION

Note: This instruction refers to operation of the minipump only and in no way pertains to the indicator it is being used with.

- A. Connect the rubber hose supplied, or other tubing of appropriate size to fit indicator, to the minipump inlet (see Fig. A). Connect other end of tubing to indicator outlet.
- B. Turn rotary (some models may have toggle) ON/OFF switch to ON position. Verify that pump is pulling sample, by blocking inlet. If pump stops or slows down, it is operating satisfactorily.
- C. When recharging of battery is necessary, plug line cord (supplied) into 110VAC outlet. Plug other end into minipump charging socket above ON/OFF switch. Plug is keyed for proper polarity.

III. MAINTENANCE

The #80-0101 minipump is a durable device which will operate for hundreds of hours without replacement of major components.

In the event it becomes necessary to replace components such as the motor or hub/diaphragm assembly, refer to drawing 1010-A39 for part number and description. This drawing also serves as a disassembly/assembly guide for any pump maintenance.

- A. Before any maintenance operation can be carried out the pump must be removed from the plastic enclosure. Proceed as follows:

1. Remove minipump assembly from leather carrying case.
2. Remove two 3x20 mm screws from upper right and lower left corners of plastic enclosure. Separate case halves.
3. Remove two 3x4 mm screws from upper left center of enclosure. Pump will fall free of enclosure and is accessible for any service operation.

(Note: Reassemble in reverse order)

- B. Valve cleaning/replacement

Cleaning of the pump valves is most common maintenance performed. The efficiency of the pump will be drastically reduced if foreign material accumulates under the valves. To clean valves proceed as follows:

1. Remove pump from enclosure per A.
2. Mark pump body with pencil line to index for reassembly. Remove six 3x20 mm screws and separate exhaust and intake plate.
3. Intake valve is located on raised surface of intake plate, exhaust valve in recess. Extreme caution should be exercised in handling the valves since they are easily cracked or broken.
4. Remove valve retaining screws (one per valve) and wash the intake plate assembly to remove particulates. Do not use abrasive material to clean plate surfaces.
5. Inspect valves for cracks. Replace any cracked or broken valve. Reinstall valves. At same time inspect #07-0050 gaskets and replace if necessary.
6. Reassemble pump using pencil mark for proper intake/outlet alignment. Install pump in plastic enclosure and reassemble per para. A.

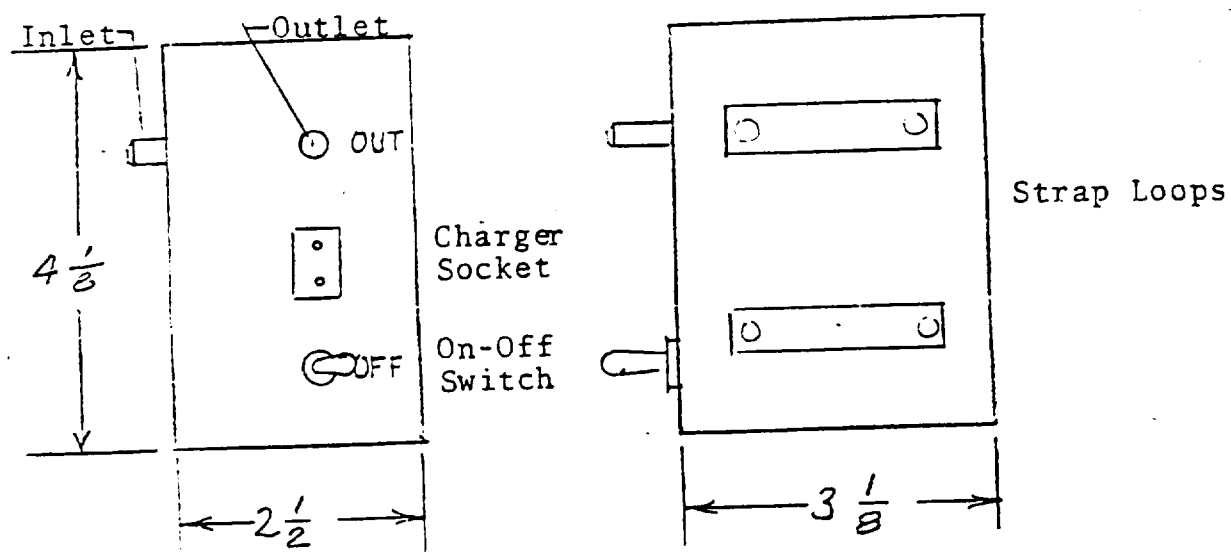
Note:

1. If pump maintenance is not practical for any reason, the entire minipump may be returned to GasTech Inc. (address below) for servicing.
2. A factory rebuilt pump assembly (pump only) is available on an exchange basis. Order:
#30-0005E Pump, exchange

GasTech Inc.
331 Fairchild Dr.
Mountain View, CA 94043

No. 80-0101 MINIPUMP

A portable battery-powered pump accessory to replace aspirator bulb in drawing samples through portable gas indicators.



MINIPUMP DIMENSIONS (drawn 1/2 size)

Fig. A

STANDARD OPERATING PROCEDURES
HYDROGEN CYANIDE

Bayer Diagnostic



Bedienungsanleitung Operating Instructions Compur Monitox SD HCN

COMPUR
Monitox

Compur Monitox SD HCN

(Abb. 1)

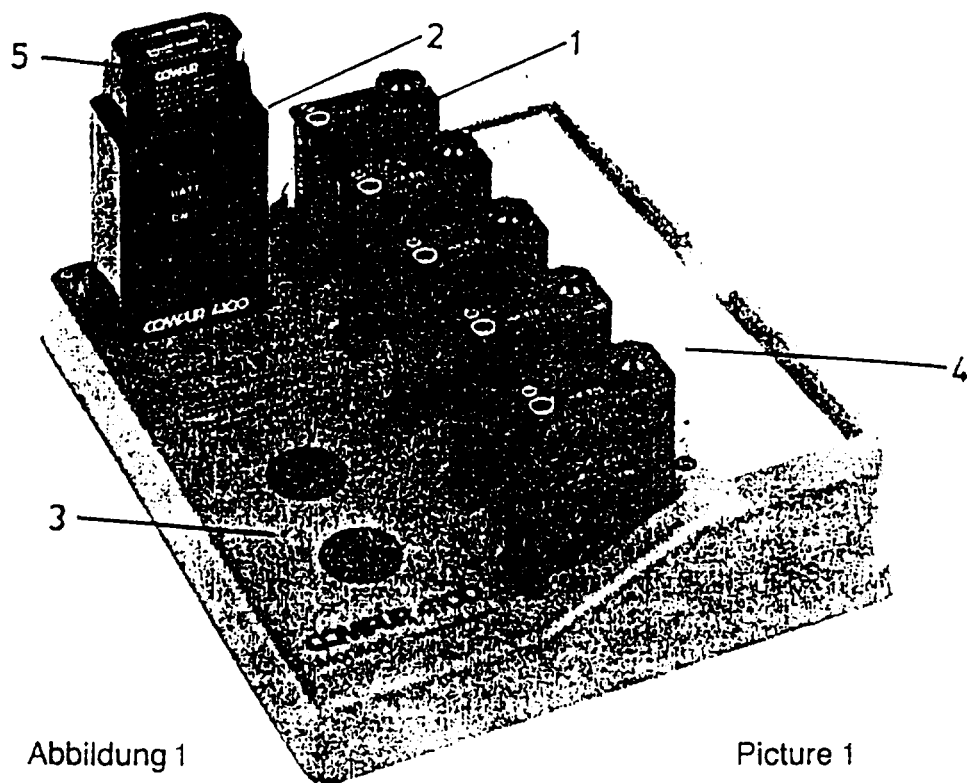


Abbildung 1

- 1 Detektor
- 2 Generator
- 3 Konsole
- 4 Protokollheft
- 5 Feuchtehaltekappe

Picture 1

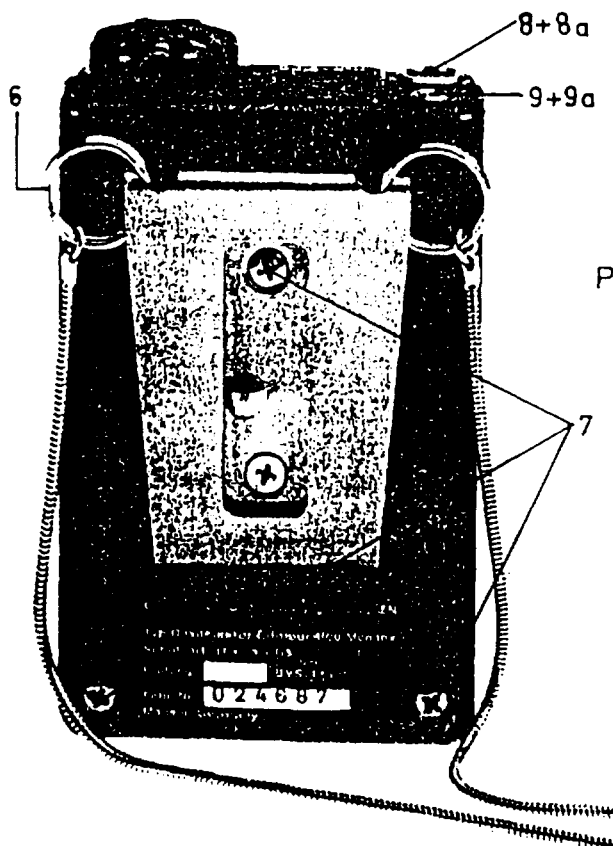
- 1 Detector
- 2 Generator
- 3 Console
- 4 Record book
- 5 Moisture cap



Picture 2

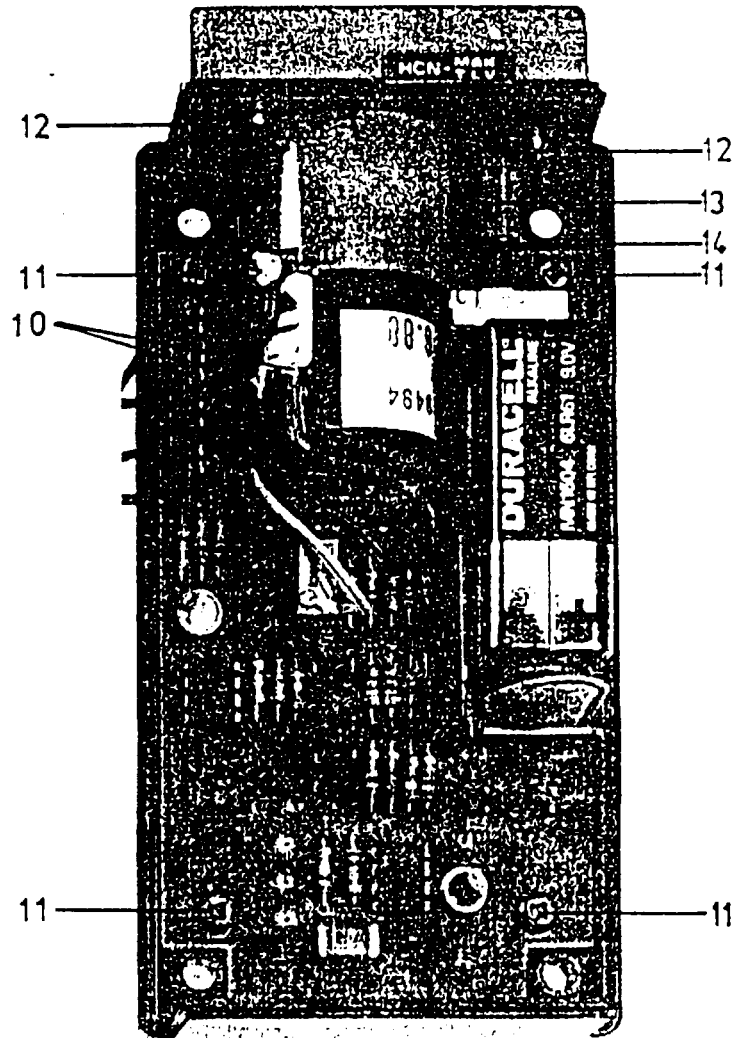


Picture 3



Picture 4

- 6 Chain
- 7 Housing screws
- 8 Dosimeter connector
- 8a Cap for socket 8
(no picture)
- 9 Earphone connector
- 9a Cap for socket 9
(no picture)



Picture 5

- 10 Fan leads
- 11 Pcb screws
- 12 Fan screws
- 13 Switch pin
- 14 Switch

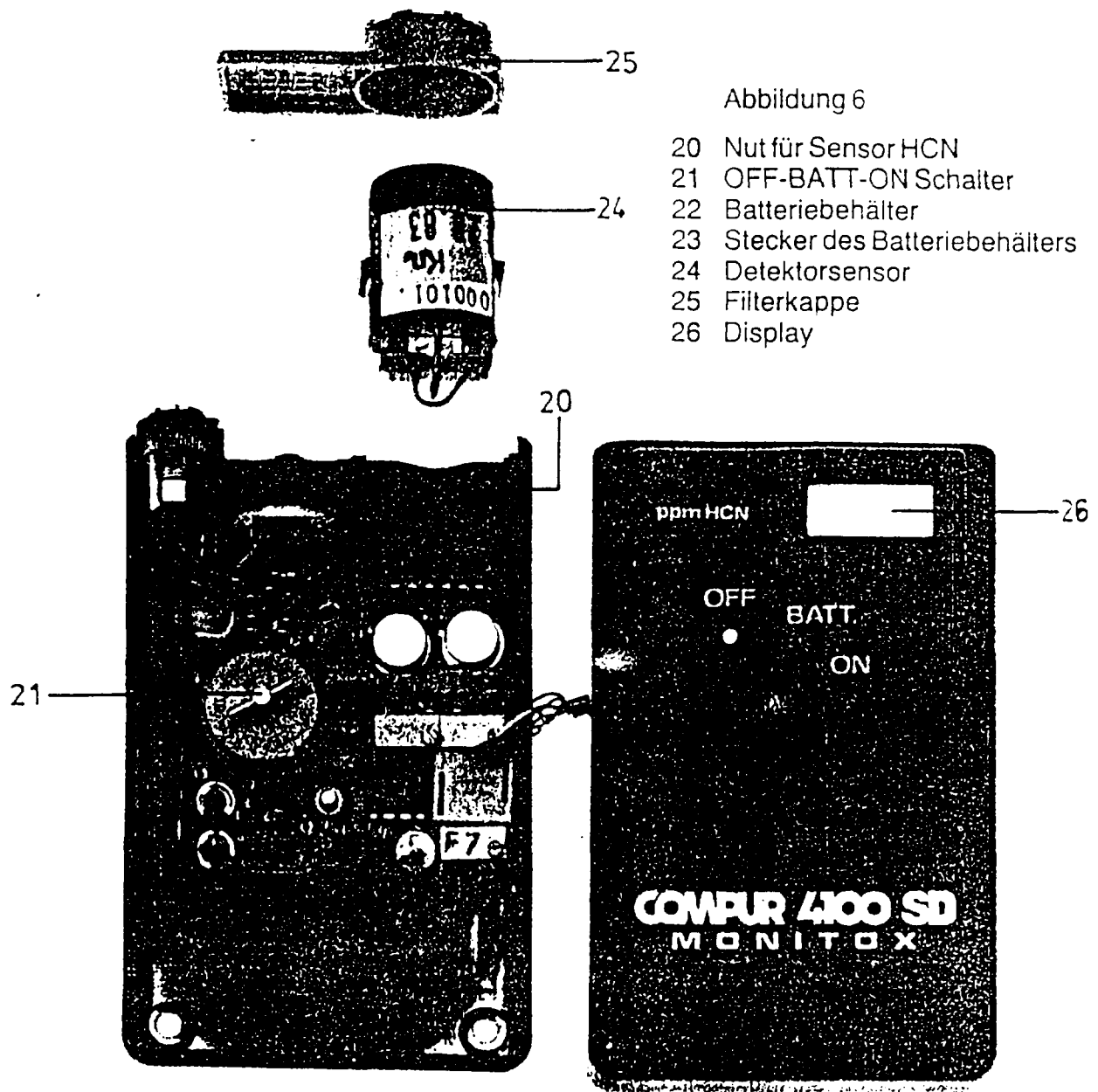
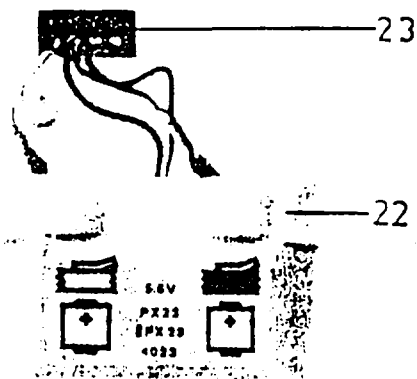


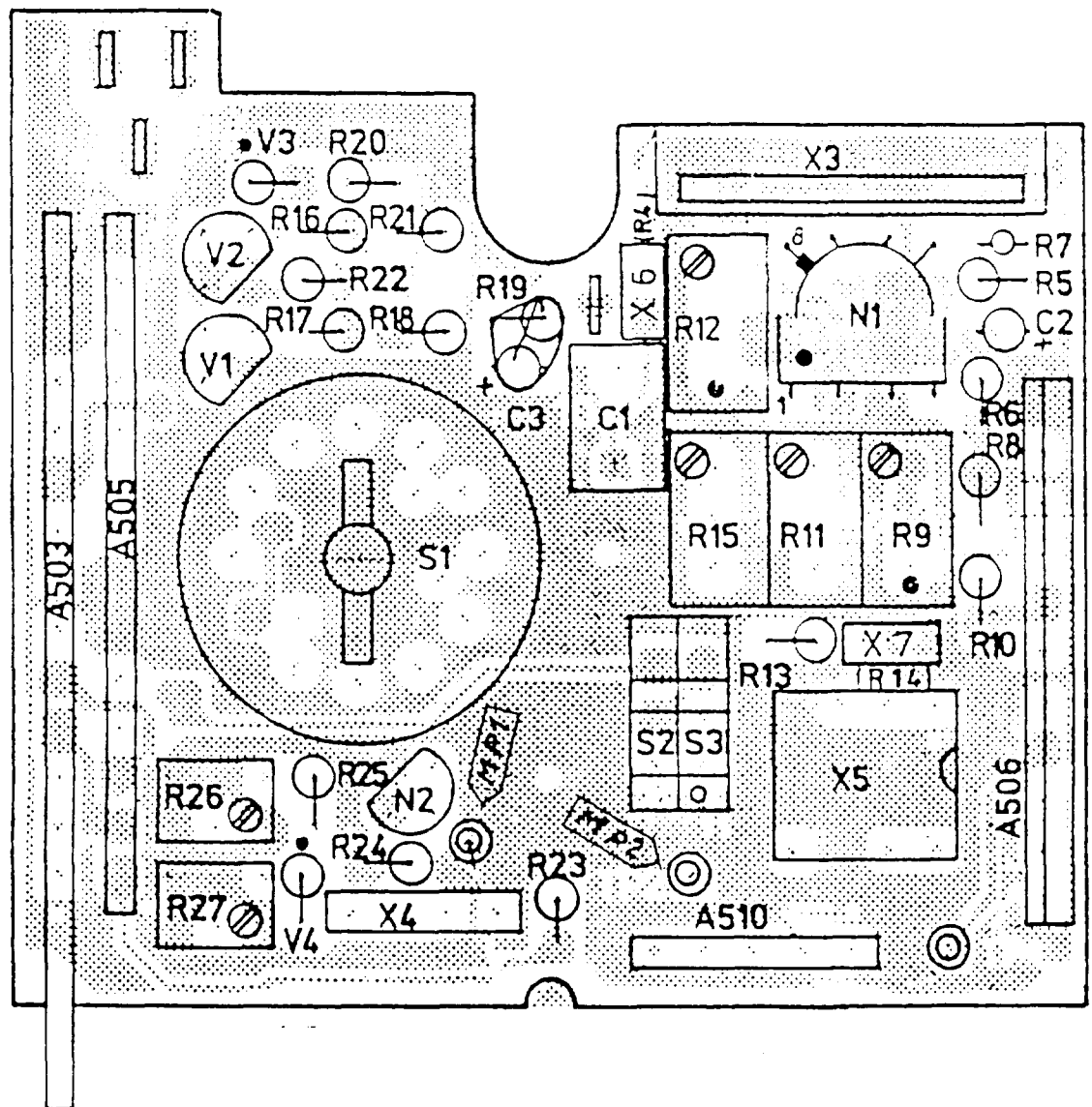
Abbildung 6

- 20 Nut für Sensor HCN
- 21 OFF-BATT-ON Schalter
- 22 Batteriebehälter
- 23 Stecker des Batteriebehälters
- 24 Detektorsensor
- 25 Filterkappe
- 26 Display



Picture 6

- 20 Groove for sensor HCN
- 21 OFF-BATT-ON switch
- 22 Battery pack
- 23 Battery pack connector
- 24 Detector sensor
- 25 Filter cap
- 26 Display



Picture 7

- S1 OFF-BATT-ON switch
- S2 Alarm 1 switch
- S3 Alarm 2 switch
- MP1 GND
- MP2 High
- R4 Stick resistor
- R14 Stick resistor
- R12 Zero point
- R9 Gain
- R15 Display
- R27 Alarm 1
- R26 Alarm 2

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We reserve the right to make changes in the technical data without notice!

Gas Detection and Warning System Compur Monitox SD HCN

(pic.1)

The Compur Monitox SD Gas Detection and Warning System comprises:

Gas Detector (alarm unit with digital display)
Gas Generator (test unit)
Console (recommended accessory)
Record book (recommended accessory)

The system is especially designed to monitor the TLV of HCN.

Caution!

Although the Monitox SD for HCN has been highly simplified for ease of operation by the user, it is nevertheless a complex measuring instrument which will operate reliably only if these operating instructions are carefully observed and if the instrument is checked regularly by the safety officer.

This applies in particular to the regular replacement of the sensors and daily functional tests. The responsibility for any changes made in the alarm threshold settings must be borne entirely by the operator; Bayer Diagnostic recommends the strict observance of the TLV.

Since the unit is designed to be intrinsically safe, all repairs must be made by the manufacturer or other approved personnel.

Bayer Diagnostic offers the instrument with following factory settings:

alarm 1 = at TLV = 10 ppm HCN
alarm 2 = at TLV = 20 ppm HCN

The detector sensor will be destroyed if the detector is permanently exposed to a HCN-concentration exceeding 1000 ppm. In this case the sensor has to be replaced.

1. Technical Description of the Compur Monitox SD Detector for HCN

1.1 Applications

Compur Monitox SD is a personal monitor for HCN (hydrocyanic acid).

It is designed to be worn attached to the clothing near the breathing zone of the person to be protected. The detector produces an audible first alarm when the HCN-concentration exceeds the TLV (factory setting: 10 ppm) and a second alarm, when it exceeds $2 \times \text{TLV}$ (factory setting: 20 ppm).

Independent of the alarm setting, the digital display shows the actual HCN-concentration in ppm (parts per million) in the normal range of 0 – 100 ppm HCN.

In conjunction with the Compur Dosimeter, the unit can be employed to register HCN-concentrations at confined spaces ranging from 0 to $10 \times \text{TLV}$.

The Compur Monitox SD cannot be used to measure process gas streams or in presence of continuous high HCN-concentrations.

1.2 Mode of Operation

Ambient air diffuses through the filter insert (a dust filter) to the measuring cell. The measuring cell, a dual-electrode electrochemical cell with an organic electrolyte gel, generates an output current proportional to the partial pressure of HCN in the air.

A series of electronic amplifiers supply a voltage signal which is fed to the comparator for the alarm threshold. If the first alarm threshold is exceeded, an intermittent tone is produced by the tone generator and loudspeaker (or earphone in very loud areas). The standardised analog signal corresponding to the actual HCN-concentrations (the TLV corresponds to 80 mV) can be fed to the Dosimeter.

The same signal is fed to the AD-converter driving the digital display. The display is adjusted to give a reading of 10 ppm at 80 mV input.

The Compur Monitox SD consists of two separate power circuits (via two miniature batteries); the circuit for the analogue part is separated from that for the alarm-generation.

When the "ON-OFF-BATT" switch is moved to the "BATT" position, the batteries will be tested before the instrument is turned on. In this switch position, the batteries are electronically tested under the high load of the final tone stages. If one of the batteries fails to reach the predetermined lower theoretical limit, no alarm will be heard.

1.3

Technical Data

Conformity certificate	BVS 82.013
Safety class	EEx ib II C T6
Dimensions	104,5 × 62 × 28 mm
Weight (with batteries)	approx. 150 g
Power supply	2 × PX 23 (5.6 V)
Service life (20°C)	approx. 1000 hours and 1 hour of audible alarm
Battery service life	approx. 36 months
Display range	0 – 100 ppm
Alarm volume	min. 80 dBA / 30 cm
Alarm levels	2 alarms, adjustable
Response time	T20 < 10 sec. T90 < 3 min.
Temperature range	0°C bis +50°C
Time to alarm 20 ppm 50 ppm	< 15 sec. < 3 sec.
Connection possibilities	earphone, dosimeter
Relative humidity	10% – 95%
Zero point drift	< 1 ppm / 6 months
Sensitivity drift	< –15% / 6 months
Service life of the sensor	min. 6 months (dependant on dose)

1.4 Cross-Sensitivities

Test-components	Test-concentration	Indication in ppm HCN
SO ₂	5000 ppm/40% rH	10
NO ₂	10 ppm	- 6
NH ₃	1000 ppm	10
CO	1000 ppm	---
CO ₂	1000 ppm	---
H ₂	1000 ppm	---
CH ₂ :CHCH	10 ppm	---
CH ₃ CN	200 ppm	---
(CH ₃)N	500 ppm	17
CH ₃ OH	200 ppm	---
COCL ₂	5 ppm	10
CL ₂	10 ppm	5
HCL	10 ppm	7
H ₂ S	2 ppm	10
Hydrocarbons, saturated	2% vol.	---
Hydrocarbons unsaturated	1% vol.	---
Aromatic compounds (also alcylated)	200 ppm	---

2. Technical Description of the Compur Gas Generator HCN

2.1 Applications

The gas generator HCN serves to enhance the reliability of the Monitox gas detection and warning system. The detector must undergo a functional test by placing it on the generator of a gas concentration exceeding the TLV ensures that the detector will respond reliably during use (pic. 3).

The gas generator, however, is not designed to generate a calibration gas of known concentration. Daily testing of the detector does not mean that the user is not recommended to change sensor sequentially.

The Compur gas generator must not be exposed to or used in explosive atmospheres.

Note:

The generator cell may dry out at very low relative humidity in the air. In this case, it is necessary to put the moisture cap delivered with the generator on top of the generator always when it is not in use.

This ensures a correct gas concentration for the detector test.

2.2 Mode of Operation

The switch on the generator is activated by placing the detector in the matching recess on the generator head.

A small fan feeds a flow of air past the generator cell directly to the detector sensor. At the same time, gas is generated electrolytically in the generator cell in such an amount that the gas concentration is high enough to cause the detector to respond within 10 seconds (alarm threshold 10 ppm). The period of gas generation is indicated by the green LED.

A red LED indicates when the battery must be replaced.

After a 10 seconds interval, gas production is terminated and the fan conveys pure air until the detector is removed.

This functional test of the detector checks any of the following defects:

- clogging of dust filter
- a malfunctioning sensor
- a malfunctioning electronics system
- a malfunctioning generator

2.3 Technical Data of Compur Gas Generator HCN

Dimensions:
133 x 65 x 40 mm

Weight (incl. batteries):
approx. 250 g

Temperature range:
0°C – 50°C

Power supply:
9 V alkali battery,
e.g. Mallory 1604

Generator cell service life:
approx. 3000 tests or for 1 year

Battery service life:
approx. 3000 tests

3. Use of the Detector and Generator

3.1 Detector Actuation and Functional Test

Battery Test:

Turn the switch on the Compur Monitox SD to "BATT". If the battery has sufficient power to operate the detector for eight hours, an audible (intermittent) tone will be heard. The LCD-display is switched off at the "BATT" test position. If no tone is emitted, this indicates that at least one of the batteries is exhausted. For safety reasons both batteries should be replaced (section 5.1.).

When the audible tone has been heard (to preserve batteries, the test should be as short as possible), the switch is moved to "ON".

The tone will cease. The LCD-display is operating now. It must show "00" ppm after some seconds.

Functional Test (pic. 3):

Place the detector on top of the generator as illustrated.

As soon as the detector sounds its alarm, it must be removed from the generator. The detector is ready for operation once the alarm has ceased.

If the detector alarm does not sound within ten seconds the detector has to be checked and serviced. If necessary, the filter cap has to be replaced (see 5.2).

It is advisable to record the test and assignment of the gas detector in the record book.

The battery test and functional test must be performed prior to each use to thus ensure maximum safety.

During the gas test the LCD-display must show the response of the sensor to HCN-concentration as well. As the alarm threshold is factoryset at 10 ppm the alarm should sound at 10 ppm. As the display reads a new value every second, the time for alarm and display of 10 ppm may be different.

3.2 Use of the Detector

The gas detector must be worn in the breathing zone of the person to be protected and the filter cap (5) should not be covered in any way.

The rubber lip on the carrying clip makes it possible to securely attach the Monitox to articles of clothing (e.g. the breast pocket).

If this is not deemed adequately secure, the chain supplied with the Monitox can be secured in the holes of the carrying clip. This enables the Monitox to be worn around the neck.

If at all possible, the filter cap should be protected from water, dust-laden air or dirt. Both, the battery and functional test should be performed before the detector is put into operation.

If HCN gas concentration in the vicinity of the sensor exceeds the set alarm value, the alarm will sound after a delay dependent on the gas the gas concentration (the higher the concentration, the more quickly the Compur Monitox SD will respond).

The alarm sounds at a level of at least 80 dBA at a distance of about 30 centimeters (12 inches).

3.3 Connecting the Earphone

When the detector is being utilised in an area with high background noise, the optional earphone should be used to be sure that the alarm will not go unnoticed. The earphone is connected to the earphone socket (9) on the detector. This socket disconnects the internal loudspeaker. If the earphone is being used, it is important that the tests also be conducted with the earphone plugged into the detector (refer to 3.1). When the earphone is not being used, the socket should be closed with the plastic cap (9a).

3.4 Connecting the Compur Dosimeter

The Compur Mini-Dosimeter can be connected to the gas detector. (refer to operating instructions for Mini-Dosimeter).

The generator test can also be carried out with the Mini-Dosimeter connected to the gas detector if the detector is turned 180° about its longitudinal axis relative to the position shown in point 3.1 and then placed on the generator in that way, that the cell fits into the recess on the generator. The functional test is then started by pushing the generator button with one's finger.

The cap should be replaced in the Mini-Dosimeter socket whenever the Mini-Dosimeter is not being used.

3.5 Digital Display

Additional to the warning-function of the gas detector its digital display gives a direct reading of the actual HCN concentration.

Thus it is possible to determine HCN concentrations below and above the TLV-level, giving the skilled worker and industrial hygienist the means to detect unusual conditions of HCN concentrations with high accuracy and resolution.

The Monitox is, however, even with its digital displays, primarily a measuring and warning device for personal protection. It has not been designed for measurement in process-control; moreover exposures to high HCN concentrations for any length of time must be avoided, as the accuracy of the reading will suffer.

3.6 Detector Deactivation and Storage

- a) brief period of inactivity
(up to a month)

the detector is deactivated
(switch to "OFF")

- b) Prolonged inactivity and storage

It is advisable to open the Monitox and remove both the sensor and batteries.

To provide them from leaking and corroding the interior of the Monitox (refer the sections 5.1 and 5.3).

Before reutilizing the Monitox a new sensor has to be installed.

4. Calibration Instruction for the Compur Monitox SD

To enhance the intrinsic accuracy of the detector for HCN it is necessary to calibrate the detector either with a HCN nitrogen mixture with definite concentration of HCN or make an electronic adjustment by means of the Compur current generator U 5900 023.

4.1 Accessories Required

4.1.1 Calibration with Gas

- a) calibration cap to place onto Monitox
- b) flow meter
- c) millivoltmeter 0 – 2000 mV
input resistance ≥ 1 Mohm
- d) tubing, set of test cables, screw-driver
- e) calibration gas known concentration,
about 10 ppm HCN in pure N₂.

Remark:

The generation and above all the stability time of HCN calibration gas is not without problems. So if only a small number of detectors are to be calibrated, the electronic method be preferred.

4.1.2 Calibration Electronical Method

- a) calibration unit (current generator)
- b) millivoltmeter 0 – 2000 mV
input resistance ≥ 1 Mohm
- c) set of test cables, screw-driver

4.2 Zero Calibration and Gain Adjustment with Calibration Gas

4.2.1 Preparation

The gas detector is opened and positioned with the electronic components upward on a non-slip surface. The cover with the digital display is carefully put aside with the display upward.

Then the unit is switched on via "BATT" position to "ON". The LCD-display should read "00" ppm after several seconds.

The excellent zero-point stability of the sensor will normally make unnecessary to adjust the zero-point. Deviations from zero are caused mostly by fault sensors.

For zero-checking remove sensor.

4.2.2

Zero-Adjustment (pic.7)

Connect millivoltmeter to tie down point (MP 2) and GND (MP 1).

If the reading is not zero in clean air, and also is not zero without sensor, potentiometer R12 (offset voltage) has to be varied until the reading is zero.

Note:

If reading is zero without sensor and not zero with the sensor, it may need up to one hour to stabilize the sensor. If a sensor has been removed for a longer period without short-circuiting the two connectors, the time to stabilize may be up to one day. A new sensor therefore has short-circuit on the small pcb, that must be broken away before inserting the sensor.

4.2.3

Gain-Adjustment with Gas

The special calibration adapter is tightly put onto the dust filter on top of the detector sensor.

Adjust a calibration gas flow through the calibration cap; flow rate should be approx. 100 ccm per minute and the inlet must be the smaller pipe; to avoid pressure variations the outlet should be free of obstacles. After 5 minutes the display of the Monitox has reached the final value.

Connect millivoltmeter to tie down point (MP 2) and GND (MP 1). Depending on the concentration of the calibration gas the following voltage should be displayed: (adjust by means of pot R9)

$$U = \frac{C \text{ in ppm}}{10 \text{ ppm}} \times 80 \text{ mV}$$

The display of the Monitox must show the gas concentration. In the opposite, adjust pot R15 until correct reading is shown.

4.2.4

Gain-Adjustment with the Current Calibrator

Each detector sensor produced by Bayer Diagnostic is supplied with an indication of the output current at 10 ppm HCN.

Never throw away packings of replacement sensors before having noted this indication!

Remove detector sensor. Insert calibration cable with the plug board into plug connector for detector sensor. The gold contacts must touch the spring contacts. Connect other side of the cable to the current generator.

Make sure of correct polarity of plugs. Switch on generator, turn button till generator display shows output current of detector sensor.

Remark:

Display always shows actual value of current. If it is "00", check the contacts!

Connect voltmeter to tie down point (MP 2) and GND (MP 1).

Adjust sensitivity by means of pot R9 until 80 mV is displayed. Monitox must now display 10 ppm. In opposite, adjust pot R15.

4.3

Setting the Alarm Thresholds

The alarms of the standard version are to be set:

1st alarm = $1 \times \text{TLV} = 10 \text{ ppm}$

2nd alarm = $2 \times \text{TLV} = 20 \text{ ppm}$

To set the alarm levels, push the mini-switches S2 to the up and S3 to the below. The display of the Monitox shows now the level of the 1st alarm threshold.

This can be adjusted by means of the potentiometer R27.

To adjust the 2nd alarm level, push the mini-switch S2 to the below the display shows now the 2nd alarm threshold.

This can be adjusted by means of the potentiometer R26.

After having adjusted the alarm levels, push the miniswitches S2 to up and S3 to below. The Monitox display shows now the actual concentration of HCN.

4.4

Concluding the Adjustment Operations

After the settings have been made, turn the switch on the pcb to "OFF" position. Make sure that the switch-handle on the cover is also in the "OFF" position. Then carefully replace the cover and fold the connecting cable between pcb and display so that it is neither squeezed in nor cracked. Tighten the screws. The Monitox is now ready for operation.

5.

Maintenance and Servicing Instructions

5.1

Battery Replacement

1. Turn switch (1) to "OFF" of the detector.
2. Remove three screws (7).
3. Turn detector over and remove front cover
Attention: Do not attempt to remove the cable between front panel and pcb!
4. Lift out battery housing, disconnect plug.
5. Unscrew and remove battery lids.
Replace batteries with + pole towards lid. Replace lids.
6. Plug-in battery plug. Ensure cable and cable socket in right position.
7. Replace battery housing and front cover, carefully adjust the cable of the front panel, so that it is not damaged by fixing the front panel; then tighten the screws.
8. Repeat battery test.

5.2

Filter Cap Replacement

1. Remove screws (7) and open detector.
2. Carefully remove sensor together with filter cap.
Pull cap off sensor.
3. Attach new filter cap (with identical gas label HCN) and return sensor to original position.
Filter cap order number appears on plate attached to inside of front panel and is listed in section 6.
4. Replace front cover and tighten screws.
5. Repeat performance test.

5.3

Sensor Cell Replacement

1. Open detector (see 5.1).
2. Remove sensor together with filter cap.
3. Remove new sensor and filter cap from storage container, pull transparent cap off the cell and replace this by the new filter cap. Correct position of filter cap is shown in illustration.
Remove short-circuit protection attached to pcb by breaking it away.
4. Proceed current calibration (see 4.2.4).
5. Replace sensor with filter cap in proper position.
6. Close Monitox.
7. Test with gas generator.

5.4

Generator Cell Replacement

1. Open housing (as when replacing battery).
2. Unsolder fan leads (10).
3. Loosen four screws (11) and three screws (12).
4. Remove outlet, gas cell and fan through the front.
5. Carefully insert replacement unit U 5820 300 consisting of outlet, cell and fan and tighten screws (12).
6. Tighten screws (11). Align circuit board so that pin (13) reliably actuates switch (14) when gas detector attached.
7. Resolder fan leads (10).
8. Reassemble generator and tighten screws.
9. Testing:
Use properly functioning gas detector for same gas.
Switch to "ON", attach. Alarm must sound after about eight seconds.

5.5

Generator Battery Replacement

Loosen four screws on rear housing panel. Carefully remove front cover. For correct positioning of battery, refer to illustration 5.

5.6 Troubleshooting

Malfunction	Remedy
Battery test no response:	Replace batteries (see 5.1)
Generator test no response:	a) Repeat test using 2nd generator, if no response, b). b) Replace filter cap (see 5.2), if not dirty, c). c) Insert new sensor (see 5.3).
Generator does not supply enough gas:	Use moisturizing cap for several days, otherwise replace generator cell (see 5.4).
Red LED lights up during test:	Replace generator batteries (see 5.5).

6. Accessories and Consumables

6.1 Accessories

	Article-No.
Console for 5 detectors and one Generator including record book	517217
Earphone	517233
Cap for socket 9	517308
Cap for socket 8	517316
Chain	804904
Gas Generator HCN	510717
Generator cell HCN	516730
Calibration gas adapter	522282
Measuring cable: threshold	517803
Measuring cable: calibration	517787
Digital Voltmeter	517571
Current calibrator	517670
Calibration cable used in connection with current calibrator	517969

6.2 Consumables

Battery PX 23 (1 pc.)	519049
Filter cap HCN	516599
Sensor HCN with filter cap	515955

Servicing Dates for Sensor Replacement

Supplementary parts order, Serial No.:
 Supplementary parts order expires on:
 Replace the sensor every 6 months.

Detector No.	Gas	Sensor Replacement						
		1	2	3	4	5	6	
								Next replacement due on
								Sensor replaced on by
								Next replacement due on
								Sensor replaced on by
								Next replacement due on
								Sensor replaced on by
								Next replacement due on
								Sensor replaced on by
								Next replacement due on
								Sensor replaced on by

Enter the sensor replacement due dates (every 6 months) beginning with the date the detector begins operation.

Do not forget to renew the supplementary parts order in due time.

Guarantee

Bayer Diagnostic GmbH as well as the company's foreign and domestic representatives guarantee within the framework of the general terms of trade the proper functioning of your Compur Monitox Gas Detector and Warning System for a period of 12 months.

This guarantee does not cover the gas detector sensor nor the batteries.

The guarantee shall take effect on the date of delivery. It is not transferable.

Bayer Diagnostic

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Subject or Title: EPA Method TO-14 Page 1 of 19
The Determination of Volatile Organics (VOCs)
in Ambient Air by GC/MS - Scan Mode

SOP No.: Revision No.: 2.3 Effective Date:
LM-ATL-7001 Supersedes: rev. 2.2 July 1, 1993

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9-1-93

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The Determination of Volatile Organics (VOCs)
in Ambient Air by GC/MS - Scan Mode

SOP No.:
LM-ATL-7001

Revision No.: 2.3
Supersedes: rev 2.2

Effective Date:
July 1, 1993

1. Scope and Application

1.1 Analytes (See Table 1)

1.2 Method detection limits (See Table 1)

1.3 Reporting limits (See Table 12)

1.4 Applicable matrices - air, vapor

1.5 Dynamic range (See Table 1)

1.6 Approximate analytical time

- 2 min. - cool down of cryotrap
- 2 min. - flush of inlet system with internal standard
- 2 min. - collection of 100 mL internal standard on trap
- 2 min. - flush of inlet system on trap
- 10 min. - collection of 500 mL of sample/standard on trap
- 2 min. - flush of trap with HP Helium and GC oven cool down
- 24 min. - GC run time

When running multiple samples, steps can be overlapped to reduce run time to approximately 30 min.

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TABLE 1. VOC Target Compounds

Compound	R.T.	Detection Limits	Dynamic Range (ppbv)
		MDL (ppbv)	
2) Dichlorodifluoromethane (Freon 12)	2.05	0.066	2-450
3) Chloromethane	2.62	0.086	4-450
4) 1,2-Dichloro-1,1,2,2- tetrafluoroethane (Freon 114)	2.66	0.046	2-290
5) Vinyl chloride	2.89	0.20	2-450
6) Bromomethane	3.34	0.072	2-450
7) Chloroethane	3.52	0.12	4-450
8) Trichlorofluoromethane (11)	3.85	0.046	2-290
9) 1,1-Dichloroethene	4.44	0.035	2-450
10) Carbon disulfide	4.54	0.049	2-360
11) 1,1,2-Trichloro- 1,2,2- trifluoroethane (Freon 113)	4.52	0.038	2-290
12) Acetone	4.62	0.063	10-450
13) Methylene chloride	5.07	0.043	2-450
14) trans-1,2-Dichloroethene	5.38	0.040	2-450
15) 1,1-Dichloroethane	5.91	0.028	2-450
16) Vinyl Acetate	6.13	0.10	10-450
17) cis-1,2-Dichloroethene	6.70	0.045	2-450
18) 2-Butanone	6.84	0.12	5-450
19) Chloroform	7.23	0.033	2-450
20) 1,1,1-Trichloroethane	7.33	0.016	2-450
21) Carbon tetrachloride	7.56	0.021	2-290
23) Benzene	7.88	0.063	2-450
24) 1,2-Dichloroethane	7.97	0.032	2-450
25) Trichloroethene	8.95	0.014	2-450
26) 1,2-Dichloropropane	9.31	0.033	2-450
27) Bromodichloromethane	9.88	0.056	2-450
28) cis-1,3-Dichloropropene	10.70	0.019	2-450
29) 4-Methyl-2-pentanone	11.11	0.085	4-450
30) Toluene	11.21	0.059	2-450
32) trans-1,3-Dichloropropene	11.82	0.085	2-450
33) 1,1,2-Trichloroethane	12.12	0.084	2-450
34) Tetrachloroethene	12.19	0.055	2-450
35) 2-Hexanone	12.78	0.12	4-450
36) Dibromochloromethane	12.80	0.048	2-450
37) 1,2-Dibromoethane	12.90	0.031	2-450
38) Chlorobenzene	13.98	0.026	2-450
39) Ethylbenzene	14.33	0.035	2-450
40) 1,4-and 1,3-(p,m) Xylene	14.61	0.14	2-580

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Supersedes: rev 2.2

Effective Date:
July 1, 1993

TABLE 1. VOC Target Compounds
(Continued)

	Compound	R.T.	Detection Limits	Dynamic Range
			MDL (ppbv)	
41)	1,2-(ortho) Xylene	15.43	0.14	2-450
42)	Styrene	15.49	0.083	2-450
43)	Bromoform	15.78	0.17	2-450
44)	1,1,2,2-Tetrachloroethane	17.18	0.055	2-450
45)	Benzyl chloride	17.30	0.029	2-450
46)	4-Ethyltoluene	17.55	0.079	2-450
47)	1,3,5-Trimethylbenzene	17.73	0.072	2-450
48)	1,2,4-Trimethylbenzene	18.55	0.064	2-450
49)	1,3-Dichlorobenzene	19.02	0.075	2-450
50)	1,4-Dichlorobenzene	19.26	0.11	2-450
51)	1,2-Dichlorobenzene	19.83	0.087	2-450
52)	1,2,4-Trichlorobenzene	21.32	0.16	4-450
53)	Hexachlorobutadiene	21.52	0.071	4-450

2. Summary of Method

2.1 A pressurized air sample is metered through a mass flow controller onto a cryogenically cooled trap. After 100 mL of internal standard and 500 mL of the sample has been trapped, a valve is switched and the trap is heated to purge the trap's contents onto the gas chromatography column. The target compounds are analyzed with a mass spectrometer operated in the scan mode.

3. Comments

3.1 Interferences

3.1.1 Gas regulators are cleaned by the manufacturer using Freon 113, which is one of the target compounds. Before using ultra high purity (UHP) Nitrogen (N₂), Hydrocarbon (HC) free air, Internal Standard (I.S.), or a target compound standard mix, each regulator should be purged a minimum of three times with the appropriate gas.

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3.1.2 Contamination may occur in the sampling system if canisters are not properly cleaned prior to use. Canisters should not be used for the collection of samples until a batch blank analysis indicates that no target compounds are present above 0.2 ppbv. All other sampling equipment including pumps, flow controllers and filters must be thoroughly cleaned to ensure that the filling apparatus will not contaminate samples.

3.1.3 High levels of CO₂ and/or moisture may limit the amount of sample that can be trapped due to plugging of the trap. High levels of CO₂ may also over-pressurize the instrument's vacuum system requiring delay of scan start time.

3.2 Helpful Hints

None

4. Safety Issues

- 4.1 In order to prevent contamination of the lab air by the samples, the vent line must be connected to the system outlet and the fume hood must be on.
- 4.2 While making standards, the fume hood must be running. When finished valves must be closed and lines vented.
- 4.3 All compressed gas cylinders must be securely fastened to a bench or wall.
- 4.4 Normal precautions should be used in the handling of liquid nitrogen (LN₂) (do not touch transfer lines as burns can result).
- 4.5 Sampling canisters should never be pressurized over 40 psig.

5. Sample Collection, Preservation, Containers and Holding Times

- 5.1 Samples should be collected in precleaned and batch analyzed SUMMA passivated canisters. A 7 micron filter should be placed on the inlet of the can to protect the valve from particulates. Canisters should never be pressurized over 40 psig.
- 5.2 The absolute pressure of the canister must be recorded before and after sample collection.
- 5.3 Samples must be kept at <25°C.
- 5.4 Canister samples should be analyzed within 14 days of collection.

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6. Apparatus and Materials

- 6.1 Gas Chromatograph - capable of subambient temperature programming for the oven and with the jet separator option (Hewlett Packard 5890).
- 6.2 Mass-selective detector - equipped with computer and appropriate software (Hewlett Packard 5970B with HP-1000 RTE-A data system).
- 6.3 Cryogenic trap with temperature control assembly (Nutech 8533 and 3538). See Figure 1.
- 6.4 Electronic mass flow controller - for maintaining constant sample flow through Nutech concentrators (Unit Instruments)
- 6.5 Chromatographic grade stainless steel tubing and stainless steel plumbing fittings.
- 6.6 Chromatographic column - DB-624 0.53 ID, 30 meter length (J&W Scientific).
- 6.7 Stainless steel vacuum/pressure gauge capable of measuring from 30" of mercury (Hg) to 40 psig. (Span Instruments)
- 6.8 High precision vacuum gauge - for making daily standards. (Wallace & Tiernan Pennwalt)
- 6.9 Pressure regulators for carrier gas and standards - 2 stage, stainless steel diaphragm.
- 6.10 SUMMA passivated canisters 6 L or 15 L (Scientific Instrumentation Specialists, Anderson Instruments) or equivalent.
- 6.11 7 micron filters (Nupro), or equivalent.

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FIGURE 1. Nutech 8533 Flow Diagram

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7. Reagents and Standards

- 7.1 4-bromofluorobenzene, 15 ng/uL in methanol (for tuning of mass spectrometer).
- 7.2 High purity helium and air for making dilutions and for carrier gas.
- 7.3 Calibration stock standards are at a nominal concentration of 1 ppmv (CS₂ is not as stable and so the concentration is 5 ppmv). Standards are prepared in a balance gas of nitrogen and are analytically certified by the supplier (Scott-Marrin and Scott Specialty). To facilitate certification by vendor, the standards were divided into 5 cylinders. (See Tables 2-7.)
- 7.4 Internal standard mix of bromochloromethane, 1,4-difluorobenzene, and chlorobenzene-d5 at 1000 ug/ml each in methanol (Supelco).

TABLE 2. Cylinder No. CC72069

Component	Concentration (v/v)
Chloromethane	0.98 ± 0.05 ppmv
Bromomethane	1.00 ± 0.05 ppmv
Chloroethane	0.96 ± 0.05 ppmv
Dichloromethane	1.08 ± 0.05 ppmv
trans-1,2-Dichloroethylene	1.08 ± 0.05 ppmv
Trichloroethane	1.07 ± 0.05 ppmv
1,2-Dichloroethane	1.10 ± 0.05 ppmv
1,1,1-Trichloroethane	0.99 ± 0.05 ppmv
Tetrachloromethane	1.01 ± 0.05 ppmv
1,2-Dichloropropane	1.08 ± 0.05 ppmv
cis-1,3-Dichloropropene	1.03 ± 0.05 ppmv
trans-1,3-dichloropropene	1.20 ± 0.06 ppmv
Dibromochloromethane	1.13 ± 0.05 ppmv
Tetrachloroethylene	1.14 ± 0.05 ppmv
Ethylbenzene	1.20 ± 0.06 ppmv
p-Xylene	1.20 ± 0.06 ppmv
Styrene	1.25 ± 0.06 ppmv
1,1,2,2-Tetrachloroethane	1.24 ± 0.06 ppmv
Bromodichloromethane	1.08 ± 0.05 ppmv
Trichloroethene	0.82 ± 0.05 ppmv
Acetonitrile	1.00 ± 0.05 ppmv
Nitrogen	Balance

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TABLE 3. Standard Cylinder No. CC72058

Component	Concentration (v/v)
Carbon Disulfide	4.86 ± 0.1 ppmv
Nitrogen	Balance

TABLE 4. Standard Cylinder No. CC72063

Component	Concentration (v/v)
Vinyl Chloride	1.00 ± 0.05 ppmv
1,1-Dichloroethene	1.08 ± 0.05 ppmv
1,1-Dichloroethane	1.06 ± 0.05 ppmv
2-Butanone	1.02 ± 0.05 ppmv
cis-1,2-Dichloroethene	1.07 ± 0.05 ppmv
Benzene	1.07 ± 0.05 ppmv
4-Methyl-2-pentanone	1.09 ± 0.05 ppmv
1,1,2-Trichloroethane	1.06 ± 0.05 ppmv
Toluene	1.08 ± 0.05 ppmv
2-Hexanone	1.18 ± 0.05 ppmv
Chlorobenzene	1.08 ± 0.05 ppmv
m-Xylene	1.11 ± 0.05 ppmv
o-Xylene	1.12 ± 0.05 ppmv
1,2-Dichlorobenzene	1.25 ± 0.05 ppmv
Acetone	0.99 ± 0.05 ppmv
1,4-Dichlorobenzene	1.04 ± 0.05 ppmv
Nitrogen	Balance

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TABLE 5. Standard Cylinder No. CC12390

Component	Concentration (v/v)
Freon-12	1.015 \pm 0.05 ppmv
Freon-114	0.95 \pm 0.05 ppmv
Freon-11	0.94 \pm 0.05 ppmv
Freon-113	0.99 \pm 0.05 ppmv
n-Hexane	1.02 \pm 0.05 ppmv
1,2-Dibromoethane	0.99 \pm 0.05 ppmv
4-Ethyltoluene	0.89 \pm 0.05 ppmv
1,3,5-Trimethylbenzene	0.95 \pm 0.05 ppmv
1,2,4-Trimethylbenzene	0.92 \pm 0.05 ppmv
Nitrogen	Balance

TABLE 6. Internal Standard Liquid Mix

Component	Concentration (ug/ml)
Bromochloromethane	1000
1,4-D,fluorobenzene	1000
Chlorobenzene-d5	1000

TABLE 7. Standard Cylinder No. ALM 002636

Component	Concentration (v/v)
Benzyl chloride	0.737 ppmv
1,3-Dichlorobenzene	0.768 ppmv
1,4-Dioxane	0.895 ppmv
Hexachloro-1,3-butadiene	0.804 ppmv
Bromoform	0.84 ppmv
1,2,4-Trichlorobenzene	0.898 ppmv
Vinyl acetate	0.838 ppmv
Nitrogen	Balance

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3. Procedure

3.1 Sample Preparation

- 3.1.1 The pressure of the sample canister is checked and recorded by attaching a vacuum/pressure gauge to the top valve of the canister (the gauge should be rinsed for few seconds with HC free air by physically holding against the air outlet and flushing). The canister valve is opened briefly and the pressure is recorded. If the pressure is less than 10 psig, pressurize the canister to 10 psig with HC free air.
- 3.1.2 If the canister pressure is increased, a dilution factor (DF) is calculated and recorded.

$$DF = \frac{Y_a}{X_a}$$

Where: X_a = absolute canister pressure before dilution

Y_a = absolute canister pressure after dilution

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3.2 Daily GC/MS Tuning

- 3.2.1 At the beginning of each day, or 12 hour shift, prior to a calibration, the GC/MS system must be tuned to verify that acceptable performance criteria are achieved. If any of the key ions fail the abundance criteria listed in Table 8, the system must be retuned using 4-Bromofluorobenzene (BFB).
- 3.2.2 For tuning, the cryotrap is not used and should be left at 150C. Alternatively the trap can be cold or cooling down but should be out of line with the column. The GC program (see Table 9) is initiated by using the BAMON commands. The GC programs are named "GCBFB1" and "GCBFB2." This downloads the program from the data system to the GC. Once the oven has stabilized, the remote start light will turn on and the system is ready for injection.

2 uL of a 25 ng/uL 4-bromofluorobenzene (BFB) standard is injected into the injection port of the Nutech and the remote start button is activated.

TABLE 8. 4-Bromofluorobenzene Key Ions and Ion Abundance Criteria

Mass	Ion Abundance Criteria
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	Base Peak, 100% Relative Abundance
96	5 to 9% of mass 95
173	<2% of mass 174
174	>50% of mass 95
175	5 to 9% of mass 174
176	>95% but <101% of mass 174
177	5 to 9% of mass 176

- 3.2.3 Once the tuning run is complete (~ 6 minutes), type in the command: "TRF, TUNVOA, data file". This will start a program that will evaluate the tuning analysis and print out the required information automatically. If the BFB tuning criteria cannot be met on the first injection, retuning the instrument with PFTBA and or system maintenance may be required prior to re-injection of BFB.

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TABLE 9. BFB Tuning Method

Enter the name of the method file: GCBFB1

M E T H O D F I L E L I S T

Method file:	GCBFB1	GC type:	5890	Run type:	SCAN, GC, E1
	GCBFB2	Column:	Cap	Splitless:	Yes

Temperature:	Inj.P	Intfc	Source
	90.0	250.0	0.0

GC/DIP		LEVEL A	LEVEL B	POST RUN
Temp 1	30.0	100.0	0.0	0.0
Time 1	1.0	3.0	0.0	0.0
Rate	35.0	0.0	0.0	
Temp 2	100.0	0.0	0.0	
Time 2	15.0	0.0	0.0	

Oven equilibration Time .10 min

Run time: 6.00

Scan Start time: 2.50

Scan Parameters: Mass Range 34 to 260
Multiplier voltage: varies Number of A/D samples: 8
GC Peak threshold: 20000 counts
Threshold: 100 counts

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TABLE 10. Analytical Method

Enter the name of the method file: GCSYS1

METHOD FILE LIST

Method file: GCSYS1	GC type: 5890	Run type: SCAN, GC, E1
GCSYS2	Column: Cap	Splitless: Yes
Temperature:	Inj.P	Intfc
	90.0	250.0
		Source
		0.0

GC/DIP		LEVEL A	LEVEL B	POST RUN
Temp 1	-50.0	10.0	100.0	0.0
Time 1	1.5	0.0	0.0	0.0
Rate	50.0	5.5	40.0	
Temp 2	10.0	100.0	160.0	
Time 2	0.0	0.0	3.4	

Oven equilibration Time .10 min

Run time: 24.00

Scan Start time: 1.50

Scan Parameters: Mass Range 34 to 260
Multiplier voltage: varies Number of A/D samples: 8
GC Peak threshold: 20000 counts
Threshold: 10 counts

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3.3 Calibration

- 8.3.1 A static dilution of the stock standard gas mixtures is made in a 6 liter SUMMA canister. The high precision vacuum gauge is flushed with HC free air and attached to the top valve of a clean, evacuated canister. After recording the absolute pressure, 2.00 psi of each of the 4 standard mixtures and 0.50 psi of CS₂ is added to the canister (each regulator and the transfer line must be flushed several times before transfer of standard to the canister). Close the canister valves and replace the high precision gauge with a vacuum/pressure gauge. Pressurize the can with HC free humid air to 30 psig. This will yield a standard with a nominal concentration of 45 ppbv for most compounds (see Table 11).
- 8.3.2 An initial, minimum 5 point, curve is run in the linear working range of the system for each compound. The nominal concentration of the 6 standards will be 2.2, 11, 44, 140, 290, and 450 ppbv. A relative standard deviation (RSD) is calculated for each target analyte using the calculation in section 11 and that analyte's dynamic range. 90% of the target compounds must be less than 30% RSD to accept the curve for analysis. Refer to section 11 for RSD calculation. All compounds should have a response factor greater than 0.05.
- 8.3.3 On a daily basis, or every 12 hours of operation, a one point midrange standard (500 ml of 44 ppbv) is run to verify linearity with the 5 point curve. A percent difference is calculated between the response factors (RFs) from the continuing calibration standard and the average RFs from the initial curve for each target analyte using the calculation in section 11. 90% of the target compounds response factors must be within 30% difference of the 5 point curve average Response Factor, or a new 5 point must be run. All compounds should have a response factor greater than 0.05. The daily, one point check standard response factors (RFs) are used to quantitate the results of the samples for that shift.

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3.4 Analysis

- 3.4.1 The check standard and the QA/QC samples are analyzed the same as samples. After the one-point continuing calibration standard is analyzed and evaluated, duplicate laboratory control samples (DCS) are analyzed and evaluated (see sections 10.3 and 10.4).
- 3.4.2 Immediately following the duplicate control samples a hydrocarbon free air method blank is analyzed and evaluated (see section 10.5). The method blank consists of a SUMMA canister that is filled and pressurized with zero grade hydrocarbon free humid air.
- 3.4.3 At the beginning of a sample or standard run the sample valve is in the purge position and the trap valve is in the column position. The trap is cooled to -165C. The internal standard canister is attached and approximately 100mL is flushed through (this can be concurrent with the trap cool down). After flushing the trap valve is placed in the sample position and the trap temperature is checked to be at least -165C.

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Trapping is started by switching the sample valve to sample position and activating a timer. When 100 mL has been trapped (2 minutes at 50mL/min) the sample valve is switched to purge and the internal standard canister is closed and removed.

- 3.4.4 The sample/standard canister is then attached and approximately 100mL is flushed through. Trapping is again started by switching the sample valve to sample and starting a timer. After the appropriate amount of time (10 minutes for 500mL at 50mL/min) the sample valve is switched back to purge, the canister is closed and the data system is set up.
- 3.4.5 The GC system methods are "GCSYS1" and "GCSYS2" (see Table 10). When the GC reaches ready at the programmed start temperature the trap valve is switched to column, the cryotrap begins heating and the run is started simultaneously.
- 3.4.6 A canister filled with zero grade air is attached to the sample line in between samples. The line is allowed to flush until it is time for the next sample.

9. Data Interpretation

9.1 Qualitative Analyses

- 9.1.1 An analyte (e.g., those listed in Table 1) is identified by comparison of the sample mass spectrum with the mass spectrum of a standard of the suspected compound (standard reference spectrum). Standard reference mass spectra are obtained on each of Enseco's GC/MS systems. These standard reference spectra may be obtained through analysis of the calibration standards. Two criteria must be satisfied to verify positive identification. (1) elution of sample component at the same GC relative or absolute retention time as those of the standard component; and (2) correspondence of the sample component and the standard component mass spectrum.

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- 9.1.1.1 The sample component relative retention time (RRT) must compare within ± 0.06 RRT units of the RRT of the standard component. As an option, RT must compare within 0.5 minutes of the standard component absolute retention time (RT). For reference, the standard must be run within the same 12 hours as the sample.
- 9.1.1.2 (1) All ions present in the standard mass spectra at a relative intensity greater than 10% (most abundant ion in the spectrum equals 100%) must be present in the sample spectrum.
(2) The relative intensities of ions specified in (1) must agree within plus or minus 20% between the standard and sample spectra. (Example: For an ion with an abundance of 50% in the standard spectra, the corresponding sample abundance must be must be between 30 and 70 percent.)
- 9.1.1.3 If a compound cannot be verified by all of the criteria in the above paragraphs but in the technical judgement of the analytical chemist the identification is correct, then the compound may be reported.
- 9.1.2 For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the type of analyses being conducted. Guidelines for making tentative identification are:
 - (1) Relative intensities of major ions in the reference spectrum (ions >10% of the most abundant ion) should be present in the sample spectrum.
 - (2) The relative intensities of the major ions should agree within $\pm 20\%$. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must be between 30 and 70%).

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(3) Molecular ions present in the reference spectrum should be present in the sample spectrum.

(4) Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.

(5) Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting peaks. Data system library reduction programs can sometimes create these discrepancies.

(6) Only peaks having a total ion current greater than 10% of the nearest eluting Internal Standard total ion current will be evaluated for reporting.

(7) Semiquantitative results will be calculated for tentatively identified compounds using total ion current areas and assuming a relative response factor of 1.0.

Computer generated library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other. Only after visual comparison of sample with the nearest library searches will the mass spectral interpretation specialist assign a tentative identification.

9.2 Quantitative Analysis:

When a compound has been identified, the quantification of that compound will be based on the integrated abundance from the EICP of the primary characteristic ion. Quantification will take place using the internal standard technique. A summary table of internal standards and their corresponding primary and secondary ions is represented by Table 13. The calculation for quantitation of sample is found in section 11.

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10. QA/QC Requirements

- 10.1 The mass spectrometer must meet the tuning criteria described in Section 8.2.
- 10.2 After tuning, a single point check standard must be analyzed. Ninety percent of the target compound response factors must be within ± 30 percent difference of the five point calibration curve average response factors. If the check standard fails to meet this criterion, the system conditions should be evaluated and the standard reanalyzed. If the reanalysis fails upon several attempts to meet linearity criteria a new five point calibration curve must be run.
- 10.3 A laboratory control sample (LCS) must be analyzed after the check standard. This sample will consist of the target VOCs prepared in a separate canister at a concentration that differs from that of the check standard. Five compounds will be used to assess control for the LCS: methylene chloride, 1,1-dichloroethene, trichloroethene, toluene and 1,1,2,2-tetrachloroethane. The percent recovery for the five control compounds must be within a window of 80-115% or a window established using historical lab data.
- 10.4 For each lot of 20 samples analyzed, a duplicate control sample (DCS) must be analyzed after the LCS. The DCS sample is identical to the LCS in composition and source. The same LCS percent recovery criterion must be met. In addition, the relative percent difference (RPD) for the LCS and DCS must be $\leq 20\%$. If either of the DCS fail the criteria the system should be checked and the LCS that failed reanalyzed. Samples will not be analyzed until the DCS criteria are met. QC sample limits may change once established using historical lab data.
- 10.5 A method blank must be analyzed after the LCS or DCS. The blank results must indicate that there are no target compounds present above the reporting limits (RL). The method blank is prepared by adding zero grade humid air to a SUMMA canister. Internal standards are added to the trap and the blank is processed exactly as a sample or standard.
- 10.6 If any of the above criteria are not met, corrective actions must be implemented before analyses can proceed.
- 10.7 Internal Standards and their associated key ions are noted in Table 13. The internal standard areas are monitored for each shift by comparing the areas of the internal standards in each sample with the areas of the internal standards in the daily continuing calibration standard. Sample areas are considered acceptable if they fall between 50% and 150% of the daily standard areas. Any sample exceeding this criterium should be documented either on the analysis benchsheet or in the report narrative. The internal standard area of bromochloromethane should always be greater than 110,000 area counts

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11. Calculations

11.1 The HP data system automatically quantitates the sample results based on a 500 mL sample size. The results are in ppbv. If the canister was pressurized before analysis, the results must be multiplied by the dilution factor DF (see Section 8.1.2).

11.2 If a sample size other than 500 mL was used and/or a canister sample was pressurized, the result must be adjusted as shown below:

$$\text{result ppbv} \times \frac{500 \text{ mL}}{\text{sample volume injected}} \times \frac{\text{final psia}}{\text{initial psia}}$$

11.3 Calculation for Relative Response Factor (RRF):

$$\text{RRF} = \frac{\text{Area cpd in Std.}}{\text{Area I.S.}} \times \frac{\text{Conc. I.S.}}{\text{Conc. Cpd. in Std.}}$$

The area of the primary quantitation ion is used in calculation.
I.S.: Internal Standard

11.4 Calculation for Percent Relative Standard Deviation (%RSD):

$$\% \text{RSD} = \frac{\text{Std. Dev. of RRFs}}{\text{Mean of RRFs}} \times 100$$

11.5 Calculation for Percent Difference (%D):

$$\% \text{D} = \frac{\text{Average RRF from initial curve RRF cpd.}}{\text{Average RRF from initial curve}} \times 100$$

11.6 Calculation for Determining Concentration of Compounds:

$$\text{Conc. Cpd(ppbv)} = \frac{\text{Area Cpd. in sample}}{\text{Area I.S. in sample}} \times \frac{\text{Conc. I.S.}}{\text{RRF daily std.}} \times \text{Dil. Factor} \quad (\text{See 11.2})$$

The area of the primary quantitation ion is used in the calculation
I.S. = Internal Standard

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11.7 Calculation for Percent Recovery (%Rec):

$$\% \text{Rec} = \frac{\text{Amount cpd. recovered}}{\text{Amount cpd. spiked}} \times 100$$

11.8 Calculation for Relative Percent Difference (RPD):

$$\text{RPD} = \frac{\text{Value A} - \text{Value B}}{\text{Average of Values}} \times 100$$

12. Reporting

12.1 Reporting units are ppbv. If results are to be reported in ng/L or ug/m³ use the following equation:

$$\text{result ppbv} \times \frac{\text{Molecular weight of compound}}{24.5} = \text{ng/L} = \text{ug/m}^3$$

Note: 24.5 is the volume of ideal gas at 25 degrees Centigrade and 1 atm.

12.2 Reporting limits

See Table 12. All reporting limits and MDLs must be derived on GC/MS systems at the Enseco Air Toxics laboratory and are periodically updated. Analytes that are detected below the Reporting Limit and above the Method Detection Limit are not routinely reported. When project requirements or Data Quality Objectives specify reporting such values they will be identified and given an estimated concentration based on the following procedure:

12.2.1 Retention time criteria must be met.

12.2.2 Mass spectral criteria must be met. At a minimum, the quantitation ion and two confirmatory ions must be present. (A quantitation ion and one confirmatory ion must be present for chloromethane, chloroethane, vinyl chloride and acetone). All ions must be resolved from background and noise.

12.2.3 Values must be greater than the MDL and less than the RL.

12.2.4 All estimated values must be reported with a "J" footnote qualifier.

12.2.5 The paragraph in section 9.1.1.3 may be applied when necessary.

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12.3 Significant figures

All results should be reported to two significant figures.

12.4 No conversion of the analytical results to the standard conditions is made.

13. References

13.1 Method Source

"EPA Compendium Method TO-14. The Determination of Volatile Organic Compounds (VOCs) in Ambient Air using SUMMA Passivated Canister Sampling and Gas Chromatographic Analysis."

13.2 Deviations from Method

13.2.1 Helium is used for dilution purposes.

13.2.2 TO-14 recommends the use of a .32 mm column coupled directly to the MSD. With the HP system, the MSD can only handle flow of 1 mL/min or less. The .32 mm column provides ~ 3 mL/min. Enseco uses a .53 mm column through a jet separator.

13.2.3 TO-14 describes an inlet system that uses a vacuum to pull a slip stream sample through the trap. Enseco uses the pressure of the sample canister to drive the sample through the trap.

13.2.4 TO-14 describes the use of a Nafion dryer to remove excess moisture from air matrices. Enseco does not use a Nafion dryer since polar compounds may be lost during this removal step.

13.2.5 TO-14 describes the use of SUMMA passivated steel canisters for sampling and analysis. No mention is made of Tedlar sampling bags. Enseco analyzes samples in Tedlar bags for VOCs using the same procedures described herein. A modification to the method is noted on the final report.

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TABLE 11. Concentration of Daily Check Standard

Compound	Concentration (ppbv)
2) Dichlorodifluoromethane (Freon 12)	45.42
3) Chloromethane	43.84
4) 1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	42.50
5) Vinyl chloride	44.74
6) Bromomethane	44.74
7) Chloroethane	42.96
8) Trichlorofluoromethane (11)	42.06
9) 1,1-Dichloroethene	48.32
10) Carbon disulfide	54.72
11) 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	44.30
12) Acetone	44.30
13) Methylene chloride	48.32
14) trans-1,2-Dichloroethene	48.32
15) 1,1-Dichloroethane	47.42
16) Vinyl Acetate	37.50
17) cis-1,2-Dichloroethene	47.88
18) 2-Butanone	45.64
19) Chloroform	47.82
20) 1,1,1-Trichloroethane	44.30
21) Carbon tetrachloride	45.20
23) Benzene	47.82
24) 1,2-Dichloroethane	49.22
25) Trichloroethene	36.68
26) 1,2-Dichloropropane	48.32
27) Bromodichloromethane	48.32
28) cis-1,3-Dichloropropene	46.08
29) 4-Methyl-2-pentanone	48.76
30) Toluene	48.32
32) trans-1,3-Dichloropropene	53.70
33) 1,1,2-Trichloroethane	53.70
34) Tetrachloroethene	51.00
35) 2-Hexanone	52.80
36) Dibromochloromethane	50.56
37) 1,2-Dibromoethane	44.30
38) Chlorobenzene	48.32
39) Ethylbenzene	53.70
40) 1,4-and 1,3-(p,m) Xylene	103.36

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TABLE 11 cont. Concentration of Daily Check Standards

Compound	Concentration (ppbv)
41) 1,2-(ortho) Xylene	50.12
42) Styrene	55.92
43) Bromoform	37.58
44) 1,1,2,2-Tetrachloroethane	55.48
45) Benzyl chloride	32.98
46) 4-Ethyltoluene	39.82
47) 1,3,5-Trimethylbenzene	42.50
48) 1,2,4-Trimethylbenzene	41.16
49) 1,3-Dichlorobenzene	34.36
50) 1,4-Dichlorobenzene	46.54
51) 1,2-Dichlorobenzene	55.92
52) 1,2,4-Trichlorobenzene	40.18
53) Hexachlorobutadiene	35.98

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TABLE 12. VOC Reporting Limits

Compound	Reporting Limits (ppbv)
2) Dichlorodifluoromethane (Freon 12)	2.0
3) Chloromethane	4.0
4) 1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	2.0
5) Vinyl chloride	2.0
6) Bromomethane	2.0
7) Chloroethane	4.0
8) Trichlorofluoromethane (11)	2.0
9) 1,1-Dichloroethene	2.0
10) Carbon disulfide	10
11) 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	2.0
12) Acetone	10
13) Methylene chloride	2.0
14) trans-1,2-Dichloroethene	2.0
15) 1,1-Dichloroethane	2.0
16) Vinyl Acetate	10
17) cis-1,2-Dichloroethene	2.0
18) 2-Butanone	10
19) Chloroform	2.0
20) 1,1,1-Trichloroethane	2.0
21) Carbon tetrachloride	2.0
23) Benzene	2.0
24) 1,2-Dichloroethane	2.0
25) Trichloroethene	2.0
26) 1,2-Dichloropropane	2.0
27) Bromodichloromethane	2.0
28) cis-1,3-Dichloropropene	2.0
29) 4-Methyl-2-pentanone	4.0
30) Toluene	2.0
32) trans-1,3-Dichloropropene	2.0
33) 1,1,2-Trichloroethane	2.0
34) Tetrachloroethene	2.0
35) 2-Hexanone	4.0
36) Dibromochloromethane	2.0
37) 1,2-Dibromoethane	2.0
38) Chlorobenzene	2.0
39) Ethylbenzene	2.0
40) 1,4-and 1,3-(p,m) Xylene	2.0

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TABLE 12 cont. VOC Reporting Limits

Compound	Reporting Limits (ppbv)
41) 1,2-(ortho) Xylene	2.0
42) Styrene	2.0
43) Bromoform	2.0
44) 1,1,2,2-Tetrachloroethane	2.0
45) Benzyl chloride	2.0
46) 4-Ethyltoluene	2.0
47) 1,3,5-Trimethylbenzene	2.0
48) 1,2,4-Trimethylbenzene	2.0
49) 1,3-Dichlorobenzene	2.0
50) 1,4-Dichlorobenzene	2.0
51) 1,2-Dichlorobenzene	2.0
52) 1,2,4-Trichlorobenzene	4.0
53) Hexachlorobutadiene	4.0

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TABLE 13. VOC Key Ions

Compound	Primary	Secondary
1) Bromochloromethane I.S.#1	49	130, 128
2) Dichlorodifluoromethane (Freon 12)	85	87, 50
3) Chloromethane	50	52
4) 1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	85	135, 87
5) Vinyl chloride	62	64
6) Bromomethane	94	96, 79
7) Chloroethane	64	66, 49
8) Trichlorofluoromethane (11)	101	103, 66
9) 1,1-Dichloroethene	61	96, 63, 98
10) Carbon disulfide	76	78, 44
11) 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	101	151, 103, 85
12) Acetone	43	58
13) Methylene chloride	49	84, 86
14) trans-1,2-Dichloroethene	61	96, 98, 63
15) 1,1-Dichloroethane	63	65, 83
16) Vinyl Acetate	43	44, 86, 42
17) cis-1,2-Dichloroethene	61	96, 98, 63
18) 2-Butanone	72	43, 57
19) Chloroform	83	85, 47
20) 1,1,1-Trichloroethane	97	99, 61
21) Carbon tetrachloride	117	119, 121, 82
22) 1,4-Difluorobenzene I.S.#2	114	63, 88
23) Benzene	78	50, 52, 77
24) 1,2-Dichloroethane	62	64, 49, 98
25) Trichloroethene	130	95, 132, 97
26) 1,2-Dichloropropane	63	62, 41, 39
27) Bromodichloromethane	83	85, 129
28) cis-1,3-Dichloropropene	75	77, 39
29) 4-Methyl-2-pentanone	43	58, 100, 85
30) Toluene	91	65, 92
31) Chlorobenzene-d5 I.S.#3	117	52, 54, 82
32) trans-1,3-Dichloropropene	75	77, 39
33) 1,1,2-Trichloroethane	97	83, 85, 61
34) Tetrachloroethene	166	129, 131, 164
35) 2-Hexanone	43	58, 57, 100
36) Dibromochloromethane	129	127, 208, 131
37) 1,2-Dibromoethane	107	109, 188
38) Chlorobenzene	112	77, 114
39) Ethylbenzene	91	106, 65, 51
40) 1,4-and 1,3-(p,m) Xylene	91	106, 105, 77

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TABLE 13 cont. VOC Key Ions

	Compound	Primary	Secondary
0			
41)	1,2-(ortho) Xylene	91	106,105, 77
42)	Styrene	104	78,103, 51
43)	Bromoform	173	171,175, 93
44)	1,1,2,2-Tetrachloroethane	83	85,133,131
45)	Benzyl chloride	91	126, 63
46)	4-Ethyltoluene	105	120, 77
47)	1,3,5-Trimethylbenzene	105	120, 77
48)	1,2,4-Trimethylbenzene	105	120, 77
49)	1,3-Dichlorobenzene	146	148,111, 75
50)	1,4-Dichlorobenzene	146	148,111, 75
51)	1,2-Dichlorobenzene	146	148,111, 75
52)	1,2,4-Trichlorobenzene	180	182,109,145
53)	Hexachlorobutadiene	225	227,223